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D. N. ROBINSON, M.Sc.

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Lincolnshire Naturalists' Union

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NATURAL HISTORY

Presidential Address

Delivered at Lincoln on 9th March, 1968

by

Mrs. I. WESTON, B.Sc.

OBSERVATIONS ON GRASSES GROWING IN LINCOLNSHIRE

It is a great honour to be President of this Union. It has flourished since 1893 and its *Transactions* still co-ordinate the natural history records of the County. The change in the fauna and flora of Lincolnshire has been recorded in these volumes and records of our now extinct and rare species — such as the Lincolnshire *Selinum*, the Cranberries of the East Fen, the Corncockles and the *Lycopodiums* can be traced through them. I am very aware of the good work of former Presidents and hope that I too can contribute to botanical work in the County. I have chosen GRASSES, and to try and indicate to you a little of the fascination of this group, which many regard with the rushes and sedges, as the Greens and Dulls of the British Flora, but as a backcloth to the countryside they are ecologically very important. Economically, too, in Lincolnshire the grass family is indispensable.

In my first job in the Welsh Plant Breeding Station at Aberystwyth, I learnt forage grasses the easy way. We worked on the chromosome behaviour of grasses used in the breeding experiments and, quite frankly, I knew what the chromosomes of the bents and ryegrasses looked like before I really knew the grasses themselves. One cannot spend long in the Welsh Plant Breeding Station without being aware of the Lincolnshire connections. What was bred in the Station — the famous S. strains — was grown on a commercial scale for seed in Lincolnshire, the eastern climate being good for seed ripening and harvesting. We were always hearing about "our Lincolnshire Seed Growers" and I always wanted to come and look at the Grass Seed Harvest in Lincolnshire.

Classification and characteristics

I will return to the work at the station later, but first let us look at the botanical features of the Grasses —GRAMINEAE. Grasses are not difficult — there are 20 — 30 common ones and a few basic characters are the only essentials for generic identification. Throughout the Glumiflorae, *i.e.*, JUNCACEAE, CYPERACEAE, GRAMINEAE, there is a general tendancy (*a*) for the perianth to become inconspicuous, (*b*) towards an adaption to wind pollination with prominence of anthers and stigmas and (*c*) for the protection of the flowers by means of glumes.

There is great diversity within the GRAMINEAE — with c. 600 genera (grouped into Tribes according to form) and 8 — 10,000 species. They are of world-wide distribution and great economic importance. Genera include *Triticum* (wheat), *Hordeum* (barley), *Avena* (oat), *Oryza* (rice), *Sorghum* (millet), *Zea* (maize), *Saccharum* (sugar-cane) and also fodder grasses for grazing, hay and silage, *e.g.*, *Lolium* (Rye Grass), *Phleum* (Timothy), *Dactylis* (Cocksfoot), *Festuca* (Fescue), *Poa* (Meadow Grass).

Diagnostic vegetative characteristics include habit, rhizomes, stolons, tussocks, rounded or flattened shoots, shape of leaf blade, ligules, auricles, hairs and proportions of these characters. Diagnostic floral characteristics include the type of inflorescence — spike, or panicle of spikelets and number of flowers per spikelet. The make-up of the grass flower is a basic characteristic of the group but the glumes and pales may be awned and vary in form. The combination of these characters, used with the keys, provide generic and specific identification though the latter is often a little difficult!

Lincolnshire Grasslands

In Lincolnshire there is an enormous acreage of cereals and also of grassland. The grassland of Lincolnshire can be divided into (*a*) Cultivated grassland — meadow and pasture, improved grassland and ley; (*b*) Uncultivated or semi-natural grassland — where the unimproved and native grasses dominate; and (*c*) 'Natural Grasslands' (Coastal). The grasses in their ecological groupings will be commented on, and brief mention made of associated species.

A. Cultivated Grasslands

This is a collective term applied to grassland developed on soils (mainly neutral), derived from lowland clays and loams, *i.e.*, agricultural grassland — meadows, pastures (permanent grass, rough grazings) and leys. Although a grass grown for hay is a meadow and one grazed is a pasture, there is no real dividing line between the two and they are often mixed according to the utilisation. Permanent pasture is normally enclosed and intensively grazed or mown for hay. Some of it was derived from the tumble-down of fields formerly under the plough, whereas some is old enclosed commons, village green or shrubland grazed down. Permanent grassland will revert to scrub unless mown or grazed. It is very much richer in species than arable land or short leys. Rough grazings are not enclosed. The dominating grass species are mainly indigenous, though better known as more or less cultivated plants in grass crops.

Lolium perenne (Perennial Rye Grass). Of good value agriculturally and grows on richest soils — usually co-dominant with wild white clover. These tend to exclude other species and are much more common cultivated than wild. *Lolium italicum* (Italian Rye Grass). Often cultivated in pure stands (introduced species). *Dactylis glomerata* (Cocksfoot). Widely distributed and in hay and pasture. Often dominating verges and wood edges. *Pheum pratense* (Timothy). Tall up to 4 ft.; best in hay, disappearing in pasture. Smaller *P. bertollinii* found here too. *Alopecurus pratensis* (Meadow Foxtail). Taller, better in hay. *Cynosurus cristatus* (Crested Dogstail). Shorter and flourishes better in pasture. Has a great range of tolerance and is co-dominant on second class pastures. Spikes are unpalatable and remain unless grazed early. *Poa pratensis* and *Poa trivialis* (Meadow grasses). Occur with other species. Rarely dominant. *Festuca pratensis* and *Festuca elatia* (Wide-leaved Fescues). Occur universally but the fine leaved fescues are usually found in the semi-natural communities unless sown specially as turfs (lawns, etc.). *Anthoxanthum odoratum* (Sweet Vernal). Early, overall. *Agrostis tenuis* (Bent). Abundant where soil is poorer and more acid — bent pasture. *Bromus mollis* (Soft Brome). *Holcus lanatus* (Yorkshire Fog). Universal on poor pastures and unpalatable and weedy. *Deschampsia caespitosa* (Tufted Hair-grass). Common on poor wetter pastures, unpalatable — again more acid. *Festuca rubra* (Red Fescue). Common, over all areas in the County.

The older meadows and pastures have a variety of these species. The older seeds mixtures contained a large number of species, but the leys and newer seeds mixtures are often limited to one or two species or even a number of strains of one species. The floristic elements of the association will vary according to variations of pH. and, of course, any interference tends to reduce numbers of species. This last year in Lincolnshire I counted few communities of Green Winged Orchids. A recent survey (Ball, 1965) shows a decrease from 30 to 5 sites where flowers were found, 12 having been destroyed by agricultural development. Fields purple with Green-winged Orchids may be sights of the past and a meadow in Langworth this last year full of Meadow Saxifrage seemed to me to be an uncommon sight in the County. Cowslips too are decreasing. In wetter meadows also the associations are changing; the Hairy Buttercup seems rarer and the Crocus and Colchicum species on record for Lincolnshire seem to have gone.

With the improvement of the grasslands there is a decrease in the numbers of species, but also in Lincolnshire there is a very rapid destruction of permanent grassland to make way for the plough. The percentage of permanent grass has been halved to 17% in the last thirty years (Cornwallis, 1967). This is due mainly to the unprecedented post war agricultural changeover to cereal growing.

The wetter meadows tend to have more specific 'wet grasses' and flooded meadows often contain the water grasses.

Glyceria plicata and *Glyceria fluitans* (Flote or sweet grasses). *Atopecurus geniculatus* (Marsh Foxtail). *Glyceria maxima* (Giant Sweet-grass) is also dominant in very wet areas and surrounding pools. An interesting rarity *Poa palustris* (Swamp Meadow Grass) was recorded in 1959 at Haverholme (Howitt). (It was introduced in 1814 to this country from North America).

Under the category of cultivated grasslands come roadside verges which are often dominated by *Dactylis glomerata* (Cocksfoot), *Festuca* spp., *Arrhenatherum elatius* (Tall Oat) and often the weeds of arable land — *Agropyron repens* (Twitch) and Bromus spp. — *Bromus sterilis* and *Bromus mollis*. So too perhaps should be mentioned the remaining grasses found in the cultivated fenland areas. *Phragmites communis* (Reed), economically important once in thatching and plastering; dominant as a weed in fen dykes and wet places and providing fen habitats for birds.

Improvement of grasses has been going on for a very long time. In Lincolnshire in 1823 Mr. Whitworth, of Acre House, Normanby-le-Wold, had a collection of 60 varities of *Lolium perenne* and was awarded the Society of Arts Silver Ceres medal for Ryegrass varieties. His Lincolnshire Ryegrass — *Lolium perenne* var *stoloniferum* G. Sinclair (var *Whitworthiensis*) — underwent trials and Rev. Woodruffe Peacock wrote belating the fact that it was not used more extensively by farmers. Actually by its very stoloniferous nature it is too tenacious for present day husbandry methods.

In the Welsh Plant Breeding Station grass species are bred and improved. Indigenous strains are already adapted to climatic conditions and these are mixed with others. Selections are made for higher yield of herbage, good seed production, early bite, early flowering, palatability and digestibility, and disease resistance and strains are bred for hay, pasture, silage and dual purpose. Pedigree strains are bred at the Station. Thousands of wild plants of a species are first studied and selections made of those with desirable characteristics. These are then used as parents for new crosses. The two plants used as parents are crossed either by hand or by the 'automatic pollinating' technique or else divided up and planted out in an isolated area using the 'polycross' method. The resultant seed is progeny-tested to ensure that the desirable characters were in fact genetically controlled.

After the new S. strains have passed the Experimental and Multiplication stages they are grown commercially for seed in Lincolnshire. This seed is then sold. The Lincolnshire Seed Growers have large grass seed acreages and in the summer stands of grass for seed can be seen flowering and being harvested in the County. Great skill is needed in deciding when to harvest a grass crop. Different species show characteristic signs of ripening and the crop is either cut and stooked or combined. The acreage is not as high now due to current economic considerations.

B. Uncultivated or Semi-Natural Grasslands

There is little or no natural grassland as all the grassy areas have evolved and become adapted through the centuries by human or biotic factors. Grassland is seldom a climax stage in an ecological series, except at high altitudes and under special climatic conditions, and would revert to scrub if not influenced in some way. If the influence of man or the grazing animal were removed the normal succession would be colonisation by coarser and taller species, then hawthorn, heather or bracken and shrubby growth would precede birch and pine, etc. Therefore it is more accurate to speak of 'uncultivated or perhaps semi-natural grassland'. In as much as these grasslands are the specific habitats for many of our rarer species it is desirable to conserve representative types.

Except for the coastal regions which could be said to be the one really natural habitat, the few undistrubed grassland areas of uncultivated character we have left owe their existance to the fact that soil type (*e.g.*, sandy), drainage difficulties (wet or swampy) or degree of slope (mechanical difficulties on chalk and limestone scarps) make them an uneconomic proposition for development either agriculturally or for building. All over the County these difficulties are gradually being overcome and so it is up to the naturalist to try and conserve some of these type habitats. This in itself is useless unless specialist management for the type habitat is maintained.

The geological basis of Lincolnshire is varied, but much is obscured by glacial drift, cover sands, gravels, alluvium and marine silts. The variety of natural region, with its dependent flora, is considerable. For example sand may overlie limestone chalk or peat, and a depression in limestone may contain a peaty soil, so that calcifuges (lime-haters) will be seen in a calcicole (lime-loving) environment. Where available, therefore a drift geology map is essential, but soil creep and leaching may be added local complications.

From the main natural regions of Lincolnshire examples of grasslands will be taken (see map).

1. Western Plain. (*a*) Isle of Axholme (only remnants of fen peat), (*b*) Lower Trent warplands (silt), (*c*) Middle Trent clay and sand Lowlands, (*d*) Upper Witham, Brant and Till valleys. The river sand and gravels and heathlands of sandy Gainsborough commons gives an acid vegetation and acid grasslands.

2. Cliff, Heath, Warrens. (*a*) Warrens of Scunthorpe, Liassic scarp and heath, Winterton Heath (blown sand), (*b*) The Lincoln Cliff (limestone), (*c*) Lincoln Heath limestone, (*d*) Limestone South of Ancaster and the Marlstone scarp. Here the limestones give calcareous grasslands (basic-grassland) but in the north where the cover sand overlies the limestones, *i.e.*, on the Warrens and Heaths of Brigg, Risby, Scunthorpe, Manton and Broughton, the vegetation will be acid heathland and a mixture of alkaline and acid vegetation is found on the warrens.

3. Central Lowlands. (*a*) Lower Ancholme vale, (*b*) Upper Ancholme and middle Witham vale, (*c*) Boulder clay of South Lindsey between Wolds and Cliff. Here the lowland clays produce neutral grassland and deciduous woodlands, but the blown sands in the Market Rasen area and the river sands and gravels in the Woodhall Spa district will produce acid heathland.

4. Wolds. Chalk forms the Wolds, but it is covered by Glacial Drift and consequently a very varied flora is possible. Calcareous grassland with acid pockets.

5. Marsh — Middle and Outer Marsh — Alluvium and clay. Fattening pastures.

6. Fens. Peat, Sand, Gravel. Reedgrass.

7. Coastline — Natural saltmarsh and sand-dune associations.

Acidic and basic grasslands

Soils on moorlands and heaths are acid and give rise to acidic grasslands, soils on chalk and limestone are basic or mild and give rise to basic or neutral grasslands — subdivided into wet and dry types. A problem of nomenclature arises in Lincolnshire. The Lincoln HEATH is limestone heath and consequently basic, not ecologically a typical acid heath at all. The Tetford and Bluestone Heaths are chalk and basic, whereas the moors of Lincolnshire are lowland moors and not areas of high land. For this address, however, 'heath' will be used to denote acid heathlands only.

BASIC GRASSLANDS

(Soils in solution pH exceeds 7). The calcicoles appear where the soil is thin. In places leaching occurs and acid humus collects so that *Agrostis tenuis* may appear in pockets. Many roadside verges give good calcicole floras, whereas 'over the hedge' conditions are modified.

[*a*] Limestone Grassland. The dominant grasses on the Lincolnshire oolitic limestone are:

Bromus erectus (Upright Brome) — coarse, tall, reddish, flowers earlier. *Brachypodium pinnatum* (Tor Grass or Heath False Brome) — flowers later, very stiff spikes and shows up in a mixed sward as coarse yellow green patches. Often with *Festuca ovina*. These two are positive calcareous indicators and follow the limestone and chalk. *Briza media* (Quaking Grass) — very common on the limestone. *Koeleria cristata* (Crested Hair-grass) — silvery and very beautiful, occasional. *Trisetum flavescens* (Yellow Oat Grass) — occasional. Other grasses are Crested Dogstail (in shorter turf) and Tall Oat (as weed) and occur overall but not dominant.

The areas mentioned as examples of the limestone grassland contain a number of exciting and rare plants. On Ermine Street there are some very good stretches. At Riseholme there is little Upright Brome, but a good stand of *Brachypodium pinnatum* which I find interesting as there appears to be some variation within the species. There are tall erect plants and a lax leaved colony which are easily picked out from the road by their habit. The whole can be picked out by the yellow-green colour. The Wood False Brome — *Brachypodium sylvaticum* — grows in the small patch of woodland but is not a calcareous indicator. *Briza media* is present and acid pockets of *Agrostis tenuis*. Weedy Tall Oat and Yorkshire Fog dominate where the turf has been recently removed. Hoary Plantain is a calcareous indicator but the Yarrow, Goatsbeard and Meadow Vetchling are more general species.

The Ancaster verges are famous for their limestone flora and on some the limestone grasses dominate, but on others the associated species take first place. The flora includes Horseshoe Vetch, Rockrose, Hoary Plantain, Salad Burnet, Fairy Flax and Dropwort. On one verge the Man Orchid is at its northern limit in Britain. Near Ancaster the Pasque Flower shows its preference for the oolitic limestone in the county and is associated with *Bromus*, *Brachypodium* and Horseshoe Vetch. The Cranwell verges are rich: Dyer's Green-weed, Kidney Vetch, Horseshoe Vetch and Purple Milk-vetch are found; Clustered Bellflower is also found on nearby stretches. At Saltby the limestone verges show all the above grasses, Bee Orchid, Purple Milk-vetch and Horseshoe Vetch and, nearby, Woolley Thistle flourishes. Kirton Lindsey grassland showed Bee and Pyramid orchids.

The area of limestone grassland at Holywell is one of the richest in the County. Pasque flower, Bee and Frog orchids and Bastard Toadflax are found— the latter being at its northern limit and normally found on Southern chalk. Near Holywell the verges are rich, and Tall Broomrape is found. Waddingham has an area of limestone grassland under very favourable management. Here the association is sheep-grazed and the Crested Dog's Tail sward is short. This is the classic example of shallow, permanent dowland type of sheep-grazed pasture common a century ago. It encourages the smaller limestone rarities. Thyme, Milkwort and Spotted Orchid are here in quantity.

The Lincolnshire limestone grassland is important in having a small quantity of fascinating calcicoles — Squinancy Wort and Burnt Tip Orchis are two very rare species in the County. Pasque Flower, Man Orchid and Bastard Toadflax are interesting in that they grow on the limestone not on the chalk (where they are found in the South) and they are at their northern range limit.

[*b*] Chalk Grasslands

In 1953 Dr. J. Hope-Simpson, of Bristol University, visited Lincolnshire to investigate chalk grassland, but found that little of the grassland left on the Wolds carries the pure chalk turf as glacial boulder clays and sands cover a great deal of the area. The original Stone Age clearance of scrub and forest from the chalk hills created downland conditions (*i.e.*, semi-natural grasslands) but the open grasslands with thorn and gorse were enclosed and ploughed in 18th and early 19th centuries. Only very little is left of the grasslands and much of this is verge and quarry. Typical 'downland' turf is dominated by Sheep's Fescue and Crested Dog's Tail, but some of our Lincolnshire areas are dominated by *Bromus erectus* and *Brachypodium pinnatum*. The *Brachypodium* will extend by rhizomes and is relatively unpalatable to rabbits, but sheep will eat it. This shows how easily a balance could be upset. Crested Dog's Tail will disappear unless sheep-grazed because the coarser grasses will creep in. Ungrazed or unmown grassland can soon revert to scrub.

The chalk at Red Hill has a small grassland sward with the finest grassland species, and at Tetford Hill the verges are very rich. On Red Hill *Bromus erectus* tends to dominate, but *Koeleria cristata* and *Briza media* are present and on the slopes *Brachypodium pinnatum* stands out. Yellow-wort, Pyramid Orchid, Marjoram, Basil-thyme, Felwort, Eyebright and Salad Burnet occur and the Kidney Vetch is plentiful. This appears to be more plentiful on the chalk in Lindsey, but occurs on the limestone in the south of the County. At Tetford the association is similar. Milk-wort and Thyme are common, and fescues are found on the verges. At Swallow Wold there is an area of old chalk grassland with some overlying sand. The taller grasses — *Bromus*, *Brachypodium* and *Helictotrichon pubescens* (Hairy Oat) and *H. pratense* (Meadow Oat) occur; also *Koeleria*, *Briza* and Sweet Vernal. Areas of short turf with Crested Dog's Tail and fescue are present. The area is sheep-grazed, but there is a little gorse creeping in. The rich calcicole flora includes Frog Orchid, Purple Milk Vetch, Salad Burnet, Milkwort, Hairy Plantain and Fairy Flax; Burnt Tip Orchid has been recorded in the area. The patches of sand support *Agrostis* spp.

One cannot leave the calcareous grasslands without mentioning their suitability as a habitat for orchids. The taller grasses support the taller growing species — Pyramid, Fragrant and Man, whilst the shorter turf lends itself as a habitat for Frog and Burnt Tip orchids.

[*c*] The mixture of basic and acidic grassland found on Risby Warren

Risby Warren is the largest surviving fragment of the extensive tracts of cover sand and heathland which was common in much of north Lincolnshire. It can be compared with similar regions in the Breckland. Essentially it is sand over limestone and both acidic and basic grassland communities are seen. Where the limestone comes to the surface and the soil is thin the pH is high. In the sandy areas it is low.

The Tor Grass *Brachypodium pinnatum* acts as an indicator of the limestone areas. The yellow green patches are easily picked out. Large quantities of Purple Milk Vetch (*Astragalus danicus*) are found. This plant is important in the area (it likes sand plus lime). *Festuca ovina* is found; also *Festuca ovina* var *tenuifolia* which is usually found on dry acid soils.

Psamma arenaria was planted in 1910 to bind the sand. The sand is exposed in places and typical sand plants are seen. *Carex arenaria* (Sand Sedge) is present in large quantities. *Rumex acetesolla* var *tenuifolius* is seen on the sandy banks. *Calluna vulgaris* comes in on the acid grassland and can be seen mingling with the *Psamma*. Small sand annuals are common. Sandy warrens with miniature dune systems tend to acid grass heaths with heather and pine.

ACIDIC GRASSLANDS

In Lincolnshire cover sand over the limestone produces the richest botanical hunting grounds and the warrens, woods, commons, flashes, ponds, ditches and boggy spots produce a variety of habitat. The Appleby, Broughton, Manton, Scawby and Twigmoor areas show this, and where peat accumulates acid heaths are produced. The Manton and Twigmoor areas are open blown sand heath, but the boggy areas are dominated by *Molinia caerulea* (Purple Moor Grass) and *Myrica gale* is one of the associated species.

Grass heaths are produced in other areas on sand, gravels, sand over loam, etc. The Lincolnshire grass heaths are important. They like the same conditions as heather communities. The relation of grass heath to lowland calluna is the same as a bent-fescue pasture to upland heath and heather moor. Grazing will tend to convert to grassland and cessation to colonisation.

On dry grass heathland *Deschampsia flexuosa* (Wavy Hair Grass) is dominant. This grass heathland once covered large parts of north-west Lincolnshire, from Scotter to Gainsborough. In wetter areas *Molinia caerulea* (Purple Moor Grass) and *Deschampsia caespitosa* (Tufted Hair Grass) dominate. At Scotton (wet and dry heathland conditions) Wavy Hair Grass and heather dominate. Marsh Gentian and Asphodel and other rare species are present. These are also found at Messingham where there are sand dune blowouts and very good boggy areas with *Molinia*. At Linwood are blown sand areas, boggy patches, scrub and woodland. At Stapleford Moor is a *D. flexosa* heath with some heather and birch woodland. In lowland moor areas *Agrostis* species are very common.

Other acid grasses in the County include — *Sieglinia decumbens* (Heath Grass) which is spreading at Linwood in the central track across the heath and *Nardus stricta* (Moor Mat Grass) which is usually an upland acid grass but found sparingly at Linwood and a few other areas. Of interest is the record for *Deschampsia setacea* (Discolor), "1878 — 79: At Linwood in wet places and peaty spots with *Eriophorium* but not found after" — Lees. This is the only record for the County.

Another interesting association is the type found at Epworth where in addition to the fen peat and boggy grasses there is a drier vegetation where blown sand covers the peat. On the sandy peat fields *Apera spica-venti* (Silky Bent) is found, and *Agrostis gigantea* (Giant or Black Bent) as agricultural weeds. The *Apera* seems to like peaty sand. It was recorded here in 1898 (Fowler) 1956 (Miss E. J. Gibbons) and both were seen last year at a Union field meeting. Two other interesting grasses have been found in this area. *Authoxanthum puelii* (Annual Vernal Grass) (1951 B.S.B.I.) a sandy weed and *Alopecurus aequalis* (Orange Foxtail) (1898 Lees, "On sand by the pool near the bridge where the road turns up to the village".).

C. 'Natural Grasslands' [Coastal]

[*a*] Sand Dune Grasses

Three grasses are associated with sand dune formation and are therefore ecologically very important. The sand dune build-up is an unique process. The species arrest the blown sand and then grow upwards through it and out to the side, thus collecting the sand and forming a habitat for other species.

Agropyron junceiforme (Sand Couch). As seen at Gibraltar Point this forms the small fore-shore dunes. This species is a pioneer plant with a limited capacity for upward growth and the dunes reach 4 — 5 ft. *Psamma arenaria* (*Ammophila arenaria*) (Marram Grass). This is found in large quantities and is the major dune former. *Psamma* can continue to grow upwards through an ever increasing mound of sand and the dune increases in height with fresh *Psamma* tussocks on the tips. *Elymus arenaria* (Lyme Grass). Found with *Psamma* but in smaller quantity; taller,

greyer and stouter. These three grasses are found on the Gibraltar Point, Cleethorpes and Mablethorpe dunes and form the grass dominants of the new and green dunes. Other associated plants — *Cakile, Convolvulus maritima, Honckenya, Eryngium*, etc., are typical dune species.

The older dunes are stablised by *Festuca rubra* (Red Fescue) var *arenaria* and also *Carex arenaria* (Sand Sedge). Their rhizomatous network helps change the mobile dunes into stable ones. Gradually the Marram dies off and other plants become established. The change is gradual and Marram is found in the Sea Buckthorn and Dewberry zones at Gibraltar Point. The flora of the older dunes varies and different dominants appear. At Saltfleetby — Theddlethorpe the old established dunes have a fresh-water slack unique in Lincolnshire which carries many rare species. On the west coast of Britain there are numerous dune slack formations which support rarities, *e.g.*, Fen Orchid and *Pyrola rotundifolia*.

[*b*] Salt Marsh Grasses

Agropyron pungens (Salt Marsh Twitch). This is found dominating large areas of the established salt marsh (at Gibraltar Point almost pure stands in the drier places). At Gibraltar Point the hybrid of this grass and *Agropyron junceiforme* is found (Sinclair 1942). The hybrid has intermediate characters and an intermediate position between young dune and marsh.

Spartina maritima. This is a very rare grass of British saltmarshes. In Lincolnshire it was found by Howitt 1826 at Frieston Shore, by Simpson 1945 at Gedney, and by the L.N.U. 1951 at Wyberton. This grass is interesting in that it is the native parent for the mud coloniser *Spartina townsendii*. It also has its northern range limit in Lincolnshire.

Spartina townsendii. This famous allopolyploid (first recorded in Lincolnshire at a B.S.B.I. meeting at Frieston in 1937 where it had possibly been introduced to prevent erosion) has an amazing history. Unlike *Poa annua* and *Dactylis glomerata*, allopolyploids of ancient origin, this has evolved recently. It was found in Southampton water and assumed to be a cross between *Spartina maritima* (native) x *Spartina alterniflora* (American). The first collections were of sterile plants (1870) but the subsequent collections (1878) included a more robust fertile grass. The fertile hybrid is called *Spartina townsendii. Spartina maritima* has 60 chromosomes and *Spartina alterniflora* 62 (Marchant). The sterile hybrid has 62, but the fertile hybrid shows numbers — 120, 122, 124. Therefore the chromosomes have doubled up, giving the fertile allopolyploid. This hybrid spread; by 1915 it had established itself in south coast estuaries and from 1920's artificial plantings have given a figure of nearly 30,000 acres of tidal flats being colonised.

The grass tends to colonise bare mud in front of existing salt marshes but it often migrates into older saltings and ousts vegetation. Its power of rapid mud accretion is its outstanding characteristic and it has great importance as a stablising and reclaiming species. Thousands of cuttings and seeds have been distributed in Britain and to more than 40 countries. In Lincolnshire at Gibraltar Point there are at least 40 acres of *Spartina townsendii* on the new salt marshes. Here it tends to be mainly associated with *Salicornia*. Due to smothering of other saltmarsh vegetation its contol presents a conservation problem. In 1959 volunteers eradicated it from the old marsh as it endangered the sea lavender.

At Goxhill it looks as if it has been planted on the muddy shore. Small tufts are usually put out and these link up due to spreading rhizomatous growth. At Saltfleetby the 1962 figure was c. 200 acres of *Spartina* marsh. At Barrow Haven the *Spartina* is very fine and a fairly mature colony seems to be established.

though I have not seen the types of mature stands in this County that I have seen in the South — at Penclawdd, Aust, and Bridgewater Bay. Gray working at Tetney (Gray, 1959) concluded that the species there thrived on soft mud but did not form mature colonies and became replaced by other marsh plants.

Academically it is most interesting in that two geographically normally isolated species have crossed, and the fertility of the hybrid restored by chromosome doubling, producing the new robust allopolyploid with the fantastic spread — all within the century. The evolution of this species has been minutely recorded and advantage taken of its properties.

Puccinellia maritima (Sea Poa). Again a mud coloniser but with rooting stolons. Its stems trap the silt on estuaries and marshes and levels are raised. It forms a turft with *Festuca rubra* (Red Fescue) which is common. *Puccinellia maritima* and *P. distans* (Reflexed Poa) are found in quantity at East Halton and along the estuary where large plants of Sea Aster are co-dominant. It was interesting to hear recently of a grass new to Britain being recorded in N.E. and E. Scotland: *Puccinellia capillaris* — a relative of these two species.

Parapholis strigosa (Sea Hard Grass) is in quantity at East Halton on the mud and at Gibraltar Point in the grassy turf. The plants are very large on mud and finer in the turf. This is a very brittle grass and the spikes break horizontally at maturity. *Parapholis incurva* was recorded at Gibraltar Point in 1957 by Mrs. M. Smith. An interesting record as this is its northern limit. It is a very rare coastal species and is smaller, more rigid with curved spikes, earlier flowering than *P. stugosa* and the anthers are very small.

Other interesting coastal grasses recorded in the County include *Phleum arenarium* (Sand Cat's Tail) — not common, but it has been recorded at Mablethorpe, Skegness and Cleethorpes. *Poa bulbosa* (Bulbous Meadow Grass) — found in 1958 at Cleethorpes by Mrs. B. Watkinson. A very interesting rare grass of sandy places with a south-eastern distribution. The bulbous overwintering bases make it easily identifiable; *Alopecurus bulbosa* (Tuberous Foxtail) — a salt-marsh grass with bulbous character. Found in 1893 and 1953 at the same place on Barton-on-Humber marshes; *Corynephorus canescens* (Grey Hair Grass) — 1878 Lees; *Catapodium marinum* (Darnel Poa) — found near Grimsby/Cleethorpes; *Festuca junceiforme* (Rush-leaved Fescue) — 1911, Skegness and 1957 Chapel St. Leoards (Perring). Very rare and needs expert identification to differentiate it from very common Red Fescue; *Vulpia bromoides* (Squirrel Tail Fescue) — more common than *Vulpia myuros* (Rat's Tail Fescue), but both need searching for.

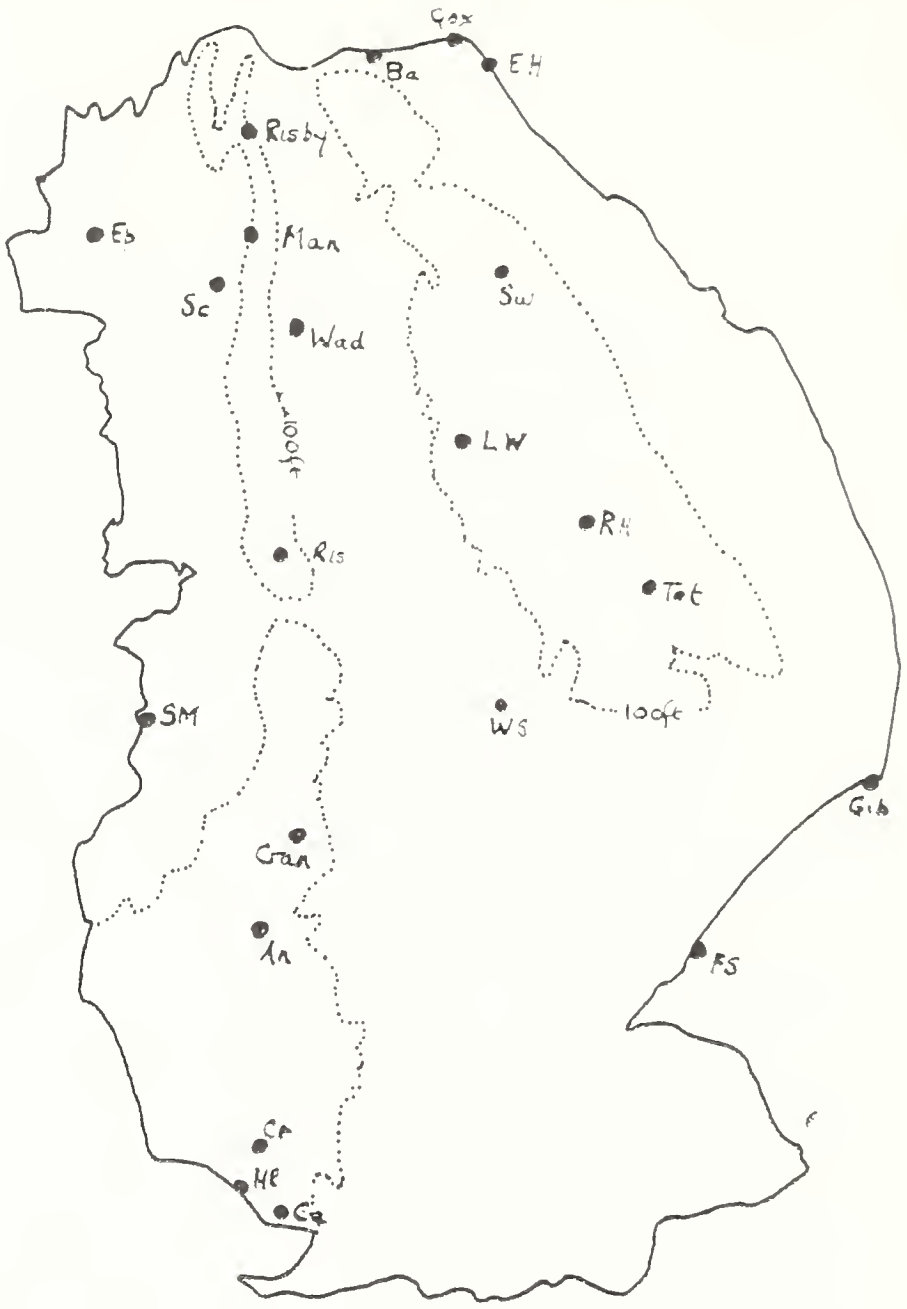
Woodland Grasses

I have not mentioned the universally common woodland grasses, but they include *Brachypodium sylvaticum* (Slender False Brome), *Bromus ramosus* (Wood Brome), *Milium effusum* (Millet) and *Poa nemoralis* (Wood Poa). Other woodland grasses include soil type species and shade tolerant species. Interesting Lincolnshire species include: *Melica nutans* (Mountain Melic) — very rare and recorded at Broughton; *Melica uniflora* (Wood Melic) — common; *Hordelymus europaeus* (Wood Barley) — very rare and recorded from Brumby (Miss E. J. Gibbons) and Twyford Forest (Cave) in 1963 and earlier, 1858 and 1958 at Diddington (Cole and L.N.U.) and 1900 Carlby (Miss Stow).

No paper on grasses growing in Lincolnshire would be complete without a mention of one of the most exciting Lincolnshire discoveries, *Nardurus maritimus* (Festuca Unilateralis). This was found on the 36th meeting of the L.N.U. on 9th June, 1903 and was a grass new to the British Flora. It was found by Miss Stow on the Cornbrash between Careby Wood and Monk's Wood, Carlby with *Vulpia bromoides*. It was prophesied that further finds in similar situations would be made and this has proved true. It has also been found at Creeton (J. H. Chandler, 1962) at Clipsham (L.N.U., 1966) and over the country from Devon and Kent to Derbyshire (Stace, 1961). It is an annual and most probably native, it has a lax habit (unlike *Nardus* which is a perennial and has a stiff habit).

Map to show places mentioned in text

Ep: Epworth
Ba: Barton
Gox: Goxhill
EH: East Halton
Sc: Scotton
Man: Manton
Wad: Waddingham
Sw: Swallow
LW: Linwood Warren
RH: Red Hill
Tet: Tetford
Ris: Riseholme
SM: Stapleford Moor
Cran: Cranwell
An: Ancaster
Cr: Creeton
Hl: Holywell
Ca: Carlby
WS: Woodhall Spa
Gib: Gibraltar Point
FS: Frieston Shore



I would like to thank in particular Miss E. J. Gibbons, our County Recorder, for her generous help in the preparation of this paper, Mr. and Mrs. G. S. Phillips for help with slides and Professor P. T. Thomas of the W.P.B.S., Aberystwyth for permission to take and use slides of the work of the Station.

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PLEISTOCENE EVENTS IN LINCOLNSHIRE: A SURVEY AND REVISED NOMENCLATURE

ALLAN STRAW, B.A., PH.D.

Introduction

In the past twenty years or so, a great deal of progress has been made in Britain in establishing the course of the Pleistocene Period, now considered by many to comprise the past two million years or so. Lincolnshire has been shaped largely within this latest of the geological periods by a variety of denudational and depositional processes, some of which may be presumed to have operated under environmental conditions different from those of today. Most recently, marine and estuarine deposition, in response to the generally rising sea-level of the past 15,000 years, has increased the area of Lincolnshire in the Fens, along the coast, and in the Humber estuary. Marine erosion has produced some of the Lincolnshire landforms, and former shorelines can be identified along the eastern and southern sides of the Wolds (Swinnerton and Kent, 1949) and on the west of the Fens between Horbling and Thurlby. The straight eastern edge of the Wolds is controlled by an old line of cliffs, now very degraded but still in places marked by slopes steeper than parts of the Chalk escarpment to the west (Fig. 4). Beneath the Lincolnshire Marsh, a broad almost intact wave abrasion platform, cut mainly on the Chalk, extends beyond the present coast, declining east north-east at about 10 feet per mile (Straw, 1961a). Though mantled by up to 100 feet of alluvium and glacial drift, this platform still accounts for the general low-lying character of the Marsh.

Glacial drift also covers extensive parts of the Wolds especially in the north around Hatcliffe and Wootton, around Kelstern, and around Swaby in the south-east. Almost all the eastern valleys of the Wolds are floored by gravels and clays, often in excess of 100 feet in thickness. Glacial till* spreads widely around Wragby, north to Brigg, and south-west to Sleaford and the Heath. North of the Witham however, it is of interest to note that the valleys are all cut into or through the till, whilst southward the Fen deposits are known to be underlain by stiff clayey tills that emerge along the southern side in Huntingdonshire and Cambridgeshire, and in the west around Sleaford. Much of Lincoln Heath is drift-covered, even at heights of more than 400 feet O.D., but west of the Jurassic scarp, till only occurs east of Gainsborough. Observations and reports on these drifts have been made for over 100 years (see for instance, Morris, 1853; Wood and Rome, 1868). Not surprisingly, a somewhat conflicting nomenclature has arisen, partly as a result of unco-ordinated efforts by different workers in the local area, and partly by the inevitable revisions that have taken place as Pleistocene glaciation has become more thoroughly understood in the rest of Britain and western Europe. Since Lincolnshire lies between Holderness to the north and Norfolk to the south-east, both classic areas for glacial investigation, names given to drifts in these adjacent regions have often been applied to Lincolnshire deposits. It is one aim of this paper to rationalize the names given to Lincolnshire drifts and glaciations, but in order to do this, some discussion of the effects of such glaciations and of the validity of subdivisions and events is necessary.

*Till is a more satisfactory term than Boulder-clay for the generally unstratified debris that is deposited directly by glacier ice, for such debris can vary greatly in stone content. Lodgement till or basal till is laid down beneath the ice, whilst ablation till accumulates on the ice surface during down-wasting and is eventually let down onto the basal till with or without intervening stratified materials.

Glacial and other influences on the landscape

Glaciation was not the only manifestation of severe climatic conditions during the Pleistocene, for Lincolnshire retains much evidence of periglacial conditions in the form of frost-produced structures in both superficial deposits and bedrock (Straw, 1963 a), and cambering and solifluction deposits along the escarpments and in the larger Wold and Heath valleys (Kellaway and Taylor, 1952: Robinson, 1967). Frost-shattered chalk gravels incorporating blown sand are well exposed along the western part of the low cliffs at South Ferriby, and many of the dry valleys in the Chalk and limestone areas owe their present form and length to greater run-off under a former condition of permafrost or permanently frozen ground, though the Cover Sands of north Lincolnshire, so extensive around Scunthorpe, Brigg and Market Rasen, were largely emplaced or rearranged by wind action under cold dry conditions (Straw, 1963 a). Appreciation of such periglacial features is essential for correct interpretation of the glacial stratigraphy, as is demonstrated below in discussion of the area around South Elkington and Welton-le-Wold.

The glacial events represented in Lincolnshire did not however occupy the whole of the Pleistocene Period. For instance glacial drifts, older than any in Lincolnshire, occur in East Anglia and parts of south central England. Further, these early East Anglian drifts rest on members of the Crags which are shelly, clayey, sandy and gravelly shallow-water marine deposits. On the bases of their faunal and pollen contents, these Crags are also referred to the Pleistocene (Funnell, 1961). A long period of non-glacial Pleistocene time in fact prevailed in many parts of Europe, a period perhaps at least as long as that during which Britain was repeatedly glaciated.

Early Pleistocene marine deposits and correlatives of the early East Anglian glacial drifts are absent from Lincolnshire. One reason may be that they have been obliterated or incorporated in the later drifts. However, there is considerable evidence that Lincolnshire was predominantly an area of denudation during the early Pleistocene, with a base-level of erosion controlled by an overall descent of sea-level from a level at least as high as the Wolds' summit (Swinnerton, 1936; Linton, 1954). Former Pleistocene shorelines have been identified in the Wolds at 420 and 220 feet O.D. (Straw, 1961 a). It is likely, during this regressive movement of sea-level, that rivers like the Humber and Trent (flowing through the Humber and Ancaster/Wash gaps respectively) and tributaries including a 'Lincoln' river, gradually brought the Cretaceous and Jurassic scarps into a greater degree of prominence, separated by a central Lincolnshire vale on the Upper Jurassic clays, and with other clay lowlands to the west. Later in the Pleistocene, these major features influenced the movements of ice sheets but were themselves remodelled by them, to such an extent that certain forms of glacial erosion are perhaps as significant in the Lincolnshire landscape as those of glacial deposition. For instance, the glacial drifts in central Lincolnshire rest in a very wide and symmetrical depression, between the dipslope of Lincoln Edge and the Cretaceous scarp, that descends gradually south into the Fen basin (Straw, 1958). The smooth form of this depression suggests a measure of ice moulding, but in fact considerable excavation of the Upper Jurassic clays, which outcrop only south of the Humber, must have taken place, for they are a major constituent of the glacial drift over large areas south-west, south and south-east of the county (Harmer, 1909). Likewise the area west and north-west of Lincoln, and the Vale of Belvoir owe some of their low-lying character to glacial erosion. The form of Lincoln Edge merits some examination in this respect. Its subdued and regular character north of Lincoln may in part be due to smoothing and moulding when the south-flowing ice passed along or slightly oblique to it. South of Lincoln, as its

altitude rises, it becomes less regular in both plan and crestline. Stronger streams of ice within the ice sheet might have worn back the Lincolnshire Limestone scarp more rapidly between Navenby and Leadenham, and might have produced or at least enlarged gaps through the Marlstone ridge at Fulbeck, between Caythorpe and Hough-on-the-Hill, west of Barkstone, and at Denton and Woolsthorpe (Fig. 1). The broad shallow nature of the Lower Lias vale between Grantham and Caythorpe and of the Ancaster gap (so visually disappointing a feature compared with the Lincoln and Humber gaps) could also be ascribed to ice-moulding.

Clearly Pleistocene events have been responsible for many of the landforms of Lincolnshire. They have also provided much of the present parent material of the soils and have strongly influenced the pattern of both larger and smaller streams. Studies of glacial geology alone cannot provide a reasonably comprehensive view of the Lincolnshire Pleistocene, for the drift sequence is incomplete and the cover is only partially preserved. Land form, soil and palaeobiological studies are also necessary, their findings complementing or confirming the results of examinations of glacial and associated deposits. The brief review of Lincolnshire glacial features that follows, leading to proposal of a modern terminology, depends to a considerable extent on a comprehensive range of studies such as those followed by the author since 1954.

The Glacial Drifts

A series of papers and Geological Survey Memoirs at the end of the 19th century (see for instance Jukes-Brown, 1885), confirmed the division of the glacial drifts of Lincolnshire into a younger series over the Marsh and on the eastern portion of the Wolds, and an older series around Kelstern and west of the Bain and Lymn valleys, as described by Wood and Rome (1868) and Wood (1880, 1882). Wright (1914) demonstrated this dichotomy for British drifts as a whole, and the two suites came to be known as the Newer Drift and the Older Drift (Table 1, Column 3). No exposure showing the superposition of the Newer Drift on the Older Drift in Lincolnshire was recorded, and in fact none has ever been seen. Field demonstration of the age difference of these deposits is mainly a geomorphological exercise, for example it can be shown that the Older Drift of Lincolnshire is cut across by the degraded cliffs of the eastern and southern Wolds (Linton, 1954; Straw, 1957) whilst the Newer Drift partly buries the cliffs and rests on the wave-cut platform.

The Newer Drift consists mainly of reddish-brown and purplish-brown till, with highly variable stone concentrations, and spreads of stratified sands and gravels that accumulated in diverse ways beyond, against or even under the parent ice sheet. This ice sheet invaded Lincolnshire from the North Sea (the limit of its maximum penetration is indicated in Figure 2) and at an early stage effectively obstructed the free egress of water through the Humber and Wash gaps, giving rise to a condition of impounded drainage in central Lincolnshire, the Fens, and the lower vale of Trent (Straw, 1963 b). The brown tills, which collectively may be called the **Marsh Tills,** are disposed in two major layers, suggesting that their deposition was a somewhat complex affair. Detailed geomorphological studies along the eastern parts of the Wolds reveal that after a lengthy period of withdrawal from its maximum extent the ice sheet readvanced to the line indicated in Figure 2 (*i.e.*, the Killingholme and Hogsthorpe moraines). Meltwater channels were cut across inter-valley divides during both phases, and some of them are still utilized by modern streams. On the bases of difference in form (essentially steepness of side) and relative position, the dry channels may be resolved into two groups, those with flanks inclined at no more than 10 to 15 degrees and the remainder with sides no

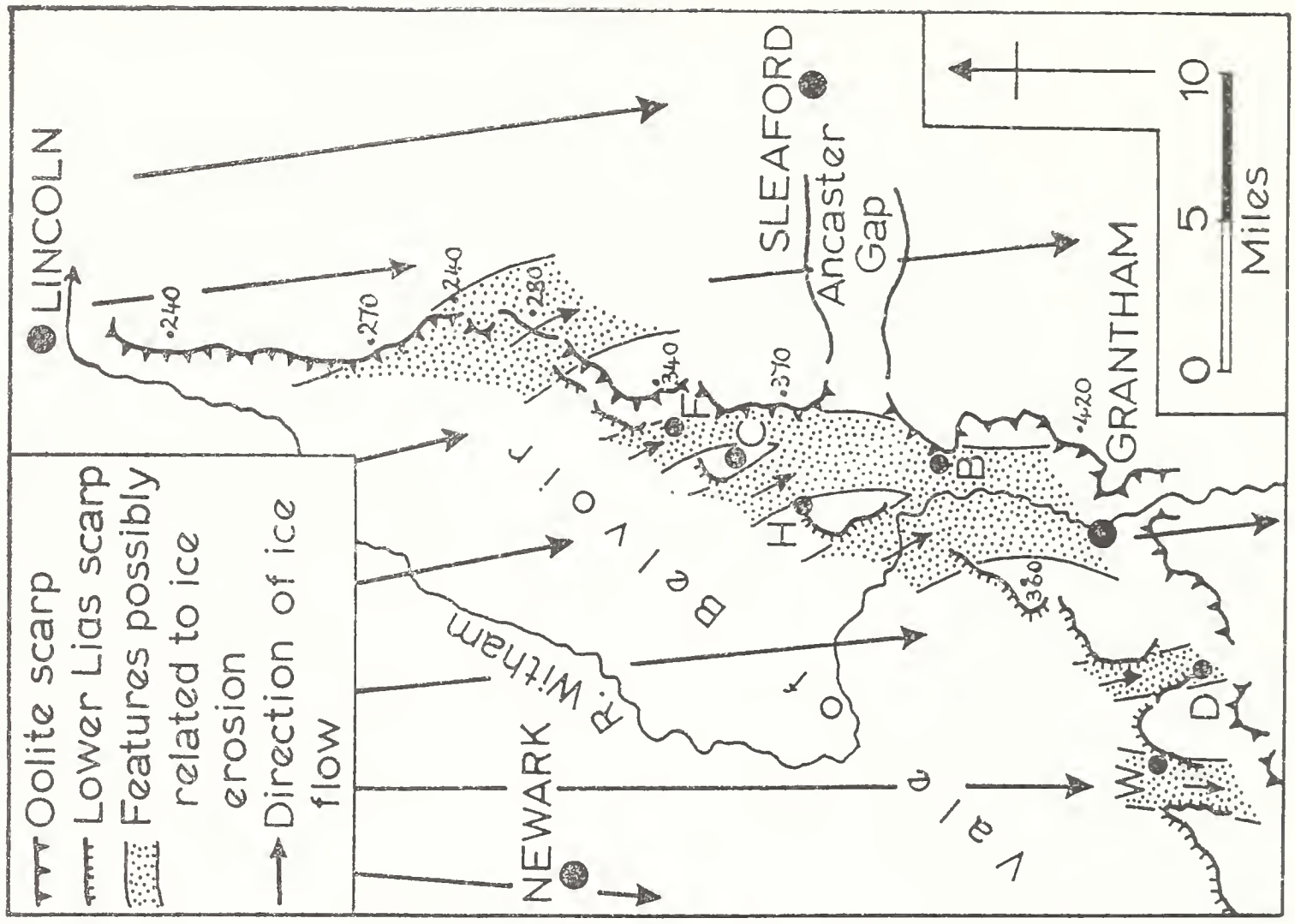

Fig. 1 *Possible glacial modification of the escarpments south of Lincoln*

(B — Barkstone; C — Caythorpe; D — Denton; F — Fulbeck; H — Hough-on-the-Hill; W — Woolsthorpe).

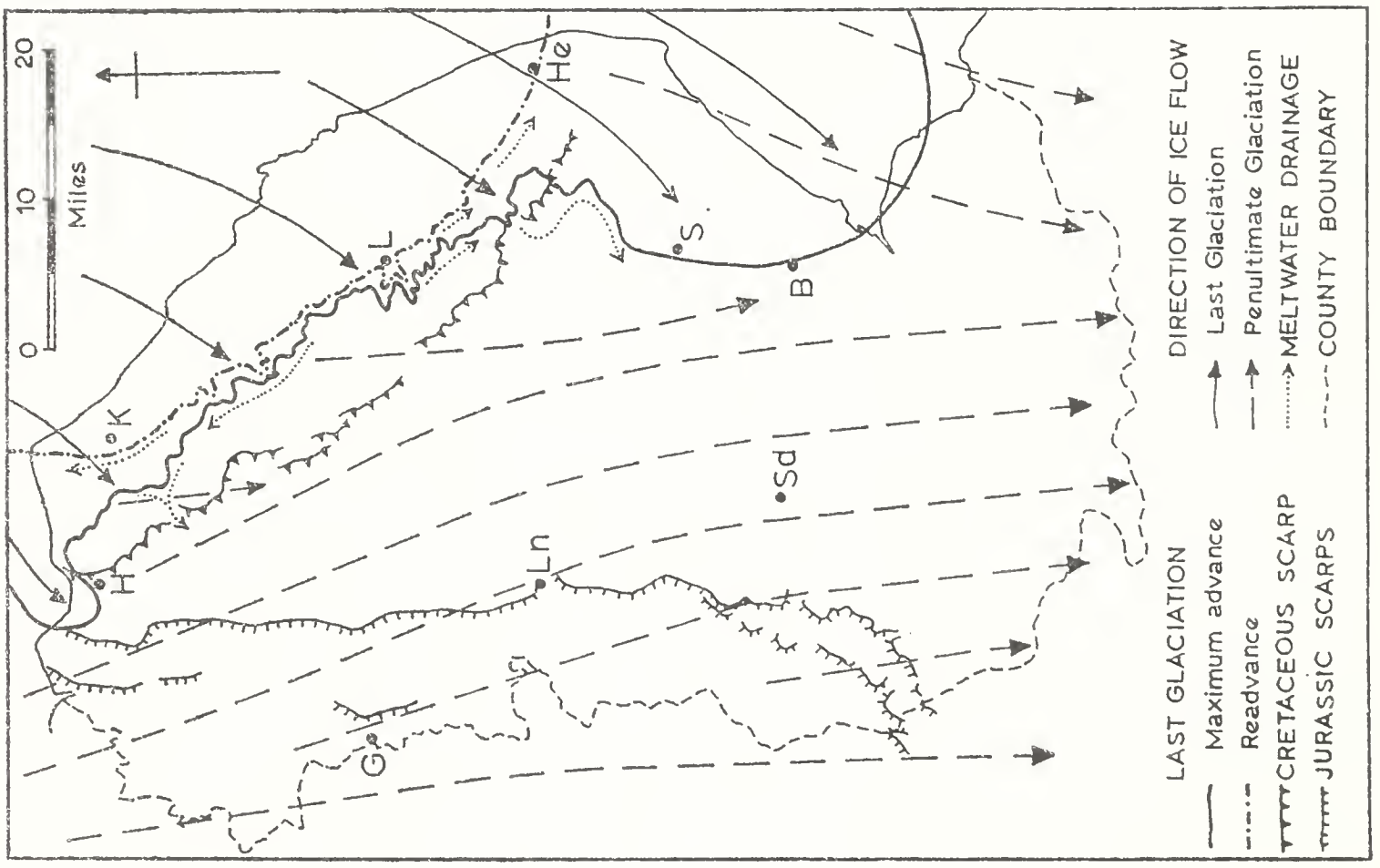

Fig. 2 *Ice sheet movements over Lincolnshire*

(B — Boston; G — Gainsborough; H — Horkstow; He — Hogsthorpe; K — Killingholme; L — Louth; Ln — Lincoln; S — Stickney; Sd — Sleaford).

steeper than 20 to 25 degrees. The former group relates to the maximum advance, whilst the latter was produced during the readvance and subsequent ice withdrawal (Straw, 1961b).

The Older Drift on the Wolds is highly chalky in content, and creamy or light yellow-brown in colour. From the Kelstern and Calcethorpe areas it spreads south-west into the Bain valley, and south toward Woodhall Spa (Fig. 3). The middle Bain valley however is largely excavated into rocks beneath this drift, which now remains particularly on the western side. In fact the river Bain took its present line along the wasting margin of the ice that laid down this very chalky **Calcethorpe Till.** The history of the river Bain is a complex one (Straw, 1966), but the disposition of the gravel and till deposits in the Biscathorpe, South Willingham and Benniworth areas demonstrates clearly that the ice stream responsible for the Calcethorpe Till was contiguous with other ice which occupied central and west Lincolnshire and which left tills of varying character or facies. Along the scarp face south of Tealby and west of the Bain valley is a narrow zone of grey and brown till, poorly exposed because it is overlaid by the Calcethorpe Till, that consists mainly of reconstituted Lower Cretaceous rocks eroded from their outcrop along the western side of the Wolds (Straw, 1961 c.). Westward of this **Belmont Till** much of central Lincolnshire is overspread by a dark grey till consisting of reworked Kimmeridge, Corallian and Oxford Clays with chalk and flint pebbles and cobbles as erratics. Particularly well preserved around Wragby, this **Wragby Till** recurs as far north as Brigg, spreads west to Reepham and passes south beneath the Witham valley and the Fens. Very little glacial drift remains over the outcrop area of the Lincolnshire Limestone, but east and south of Sleaford the till becomes browner and incorporates more Oolitic material. Toward Grantham, more Liassic debris enters into this **Heath Till,** but no sharp lateral divisions can be identified as in the Bain valley area. East of Gainsborough, thin patches of till remain on the Lower Lias outcrop. Here it is generally grey-brown, but in places is reddish due to inclusion of Keuper Marl or light coloured where there is a marked increase in chalk content believed to be of Yorkshire rather than Lincolnshire provenance.

The changing composition of the Belmont, Wragby and Heath Tills across Lincolnshire arises from the fact that the parent ice moved from the north or north-north-west generally along or slightly oblique to the strike and therefore the outcrop of the underlying Cretaceous and Jurassic rocks (Straw, 1958). The tills were deposited simultaneously therefore by ice which moved down the Vale of York and into north Nottinghamshire and central and west Lincolnshire (Fig. 2). A diffluent stream of North Sea ice also moving south was responsible for the contemporaneous deposition of the Calcethorpe Till in the Bain valley area while the main mass of North Sea ice entered the Wash gap, probably giving it its present large proportions, and invaded north and west Norfolk (Straw, 1967). During this earlier glaciation, almost the whole of Lincolnshire was submerged by ice, the thickness of which was at least 500 feet in the Fen region.

The inter-glacial period

Considerable evidence exists in Lincolnshire to support the belief that a long period of non-glacial conditions intervened between the two major glacial phases responsible for deposition of the Older and Newer Drift. Most of the Lincolnshire valleys were deepened during this period, even the Ancholme and Witham, for sea-level lower than present prevailed toward the end of it. Thus the rock floor of the Ancholme valley below Brigg is up to 100 feet below the base of the Wragby Till, and many of the Wold valleys were cut into

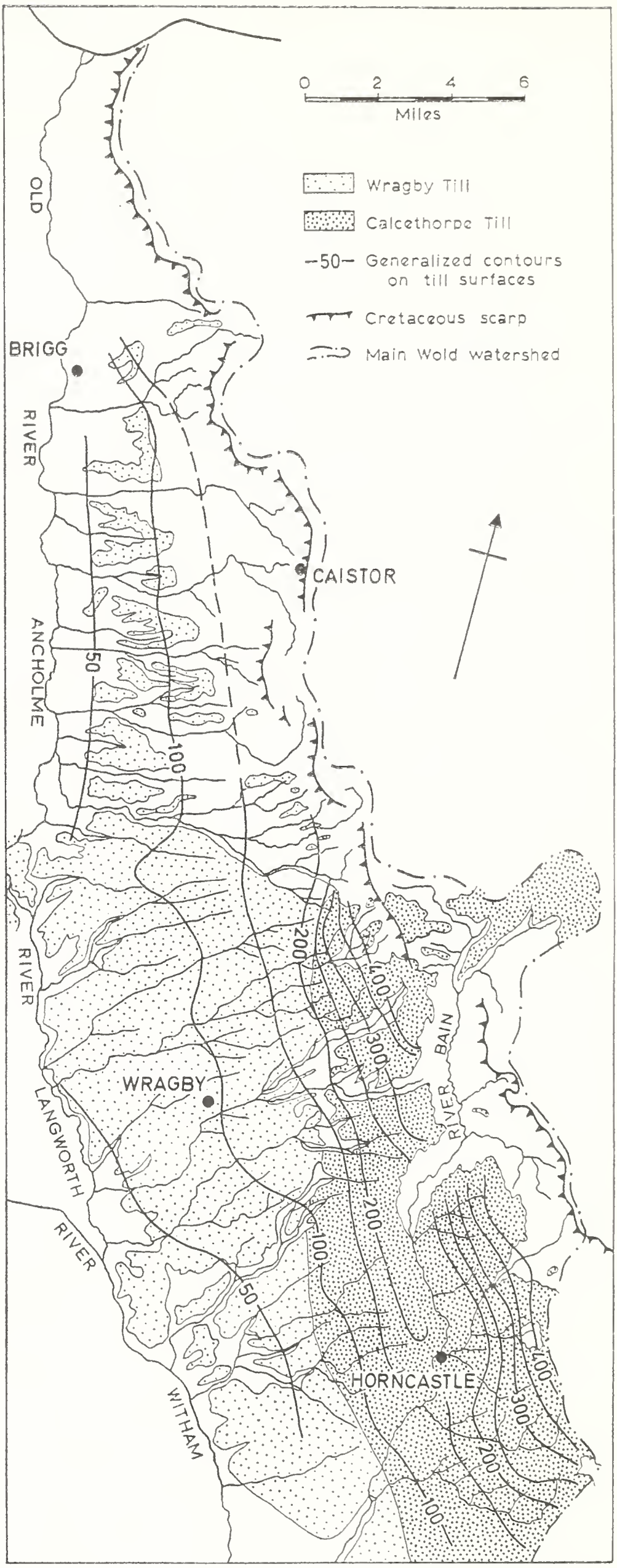

Fig. 3

Drainage of central Lincolnshire east of the Rivers Ancholme, Langworth and Witham

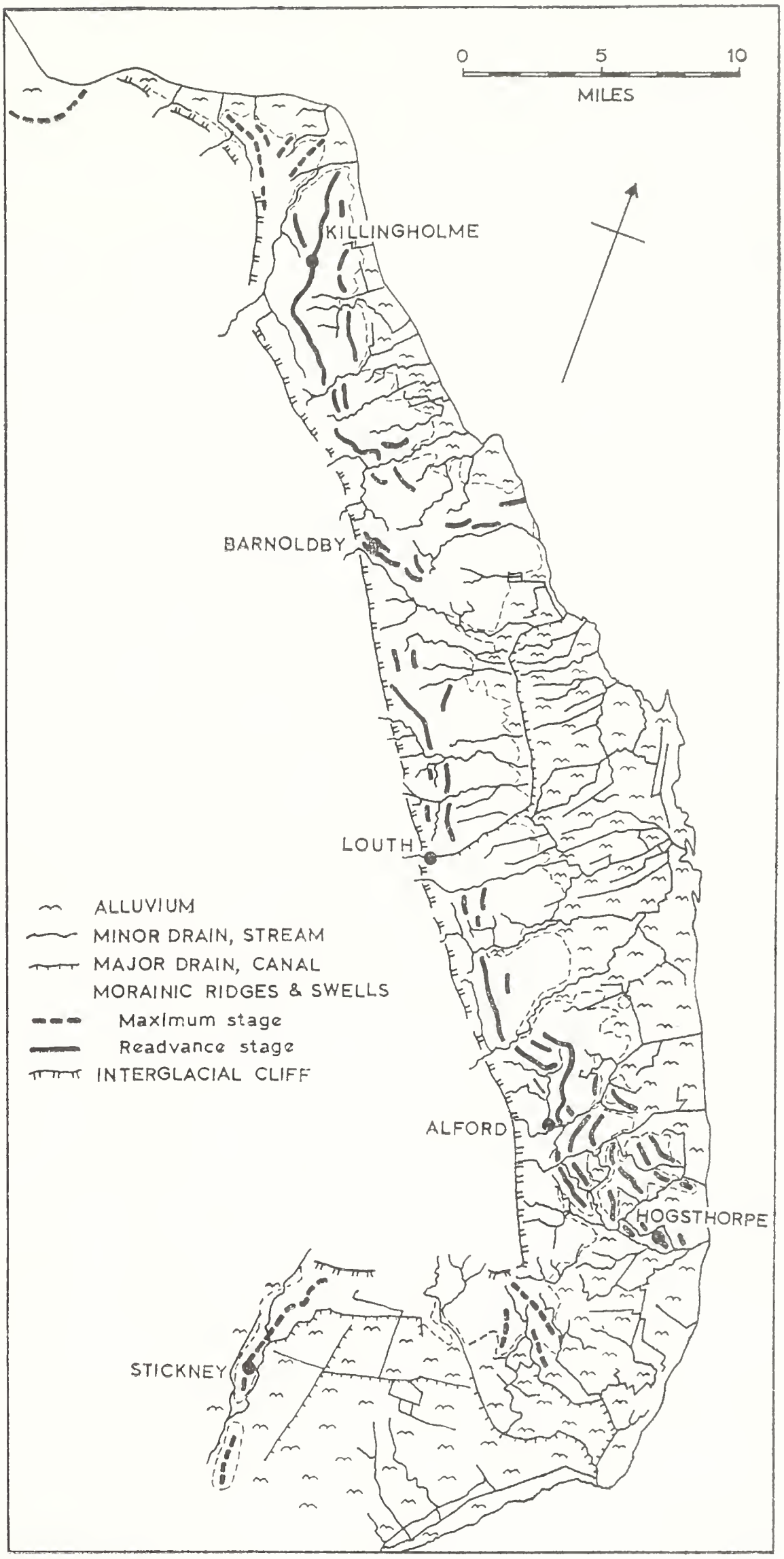

Fig. 4 *Drainage and morainic features of the Lincolnshire Marsh*

Cretaceous rocks to similar depths below the Calcethorpe Till before Marsh Till was emplaced in their floors. Prior to deepening of the Ancholme valley, erosion of the old cliffs and platform east of the Wolds must have occupied a long span of time, but even before this, sea-level had recovered to a maximum interglacial height of 70 feet O.D. as witnessed by the coastal lagoon and beach deposits preserved beneath Marsh Till at Kirmington.

Evidence for this interglacial period, which may well have lasted many tens of thousands of years, is of a varied nature, but two further examples may be given.

It is inevitable that, after deglaciation, drainage systems develop again on the land surface. Some streams, usually the larger ones, may inherit lineages of pre-glaciation valleys not totally obliterated by erosion or deposition, but many smaller ones will be newly initiated, controlled to some extent by the form of the new surface. With time, and appropriate base-level, these will cut through the drift into the rocks beneath, but their original pattern may well persist and give some indication of the nature of the deglaciation. It is instructive to compare the drainage patterns of part of central Lincolnshire (Fig. 3) with the Marsh (Fig. 4). In the latter area, several streams on the Marsh Till are influenced by morainic ridges and former ice margin positions, especially near Alford, north-west and south-east of Louth, near Barnoldby and west of Killingholme. In central Lincolnshire however, a system of markedly parallel streams exists, flowing west or south-west from the Cretaceous scarp to either the Ancholme or the Langworth-Witham rivers. Many of these streams flow on Jurassic clays, but they were initiated on a smooth gently inclined surface of Calcethorpe and Wragby Till, which is approximated in Figure 3 by the generalized contours drawn linking the crests of the inter-stream ridges. The deeper incision of these streams suggests that they are wholly older than those east of the Wolds, while their pattern, uninterrupted by morainic ridges, points to their possible origin as subglacial streams developed under a stagnant wasting mass of ice.

The second example relates to an interesting situation around South Elkington and Welton-le-Wold, west of Louth. In the Welton quarry of Stephen Toulson & Sons Ltd., a complex sequence of deposits is exposed. Up to 40 feet of thick flint outwash gravel containing lenses of sand lies beneath 10 to 20 feet of greyish-brown and reddish-brown till (Marsh Till) which is in turn overlain by a variable complex of grey and brown stone-free silts and clays, and highly chalky silts, sands and gravels, the latter frequently lacking obvious stratification. Further east, in Toulson's Elkington quarry, the Marsh Till is overlain by another sand and gravel suite, quite different from the flint gravel at Welton. Sand is the main constituent here, and like the associated gravels contains a high proportion of chalk. The well-rounded gravels include a wide variety of Palaeozoic and igneous rocks. The interpretation may be summarized with reference to Figure 5. A pause in an early ice advance into the Elkington valley from the east-north-east allowed deposition of the lower flinty gravel, which was eventually overridden by the ice. Basal till (greyish-brown till) and surface ablation till (reddish-brown till) accumulated as the ice gradually dissipated, meltwaters escaping south to the next valley through the Welton Vale gorge (Fig. 5b, position 3). The Elkington gravels represent outwash from a readvance of the ice (Fig. 5c) which did not penetrate so far, but once again meltwaters utilized and deepened the Welton Vale gorge. During this readvance, freeze-thaw processes involving solifluction brought down the highly chalky debris over the Marsh Till, and partly mixed it with the surface ablation portion of this till and the associated silty clays. The interesting point is that the highly chalky debris is derived mainly from Calcethorpe Till, not bedrock Chalk, which overspreads the rather higher ground north-west of the

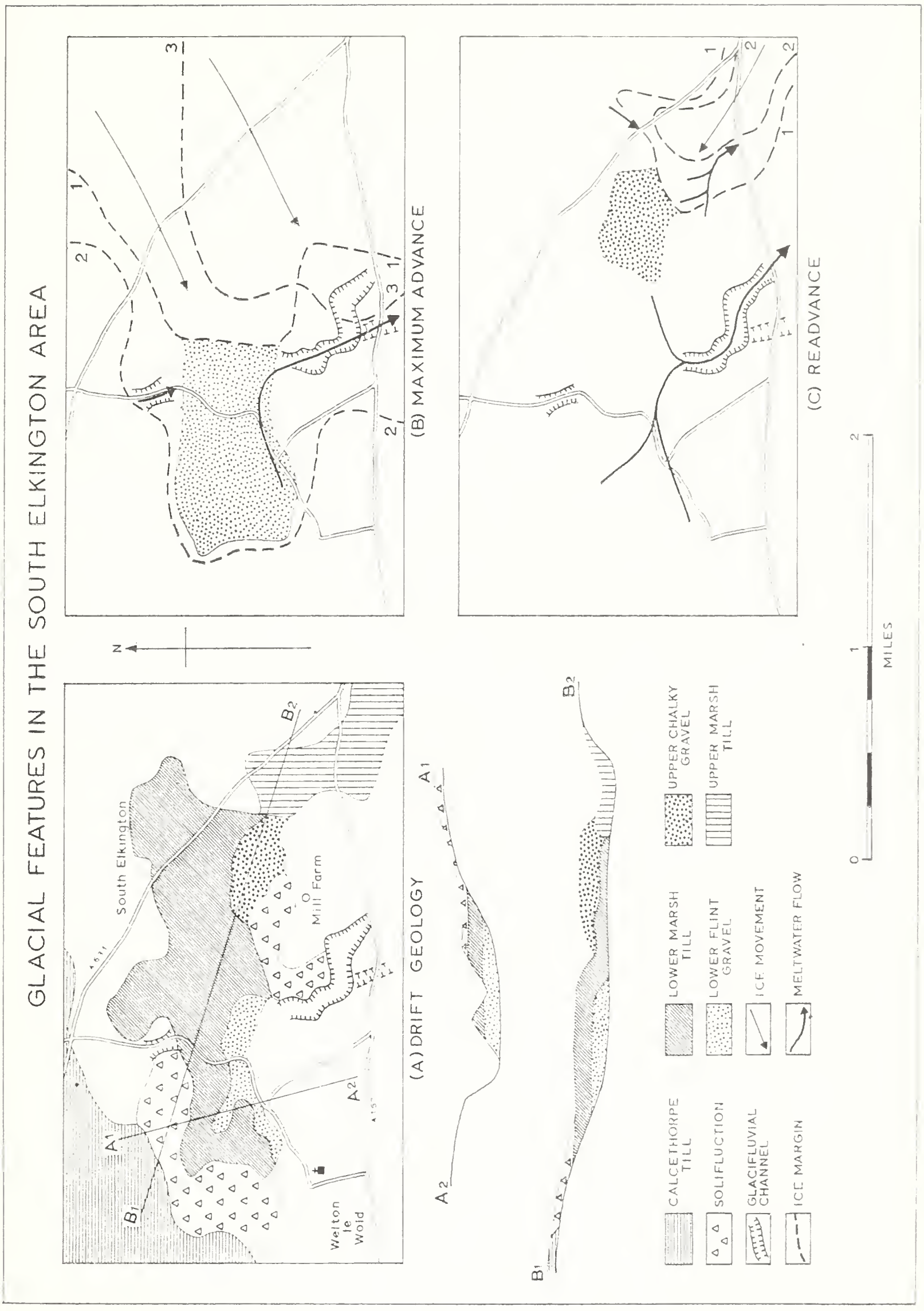

Fig. 5 *Glacial features in the South Elkington area*

Welton quarry (Fig. 5a). The inference is that the Welton and Elkington drifts were emplaced in a valley that was considerably deepened during the interglacial succeeding the Calcethorpe Till glaciation, while periglacial processes complicate the stratigraphic sequence by bringing material similar to Calcethorpe Till into a position above the Marsh Till.

In summary it can be established that Lincolnshire has experienced at least two major glacial episodes, with an intervening interglacial period, and that during the later episode ice-free areas of the county were affected perhaps a number of times by climatically severe conditions that gave rise to numerous periglacial features and deposits. It must now be determined which of the accepted British and European glaciations these refer to.

Relative dating and nomenclature

The Marsh Tills are continuous with very similar materials in Holderness north of the Humber, and in part are equivalent to the Hunstanton Till of north-west Norfolk. Re-examination of the Holderness drifts in recent years (Penny, 1959, 1964; Catt and Penny, 1966) has led to their firm correlation with the tills of northern England and Scotland. All these drifts, including the Marsh Tills, are referable to the latest of the British glaciations, generally and not surprisingly known as the **Last Glaciation** (Table 1, Col. 2, 4).

The older tills of Lincolnshire can be safely allocated to the preceding glaciation, for it is extremely unlikely that any glacial episode could have occurred between emplacement of the Wragby and Calcethorpe Tills and their correlatives, and the Marsh Till, and have left no visible manifestation. Many authorities, following Zeuner (1945) refer to this preceding glaciation as the **Penultimate Glaciation.** No deposits of the Ante-Penultimate Glaciation have so far been discovered in Lincolnshire. The terms Older Drift and Newer Drift prompted by Wright (1914) are still valid, and are particularly meaningful in Lincolnshire. For Britain as a whole however, the Older Drift includes deposits of both the Penultimate and Ante-Penultimate Glaciations (Table 1, Cols. 2, 3).

Two other systems of nomenclature are currently applied to the British glacial sequence. In East Anglia, Baden-Powell (1948) and West and Donner (1956) defined a three-fold sequence that West (1961) states as the *Lowestoft*, *Gipping* and *Last Glaciations* (Table 1, Col. 4). Palynological and stratigraphical work has established the presence of interglacial deposits in East Anglia and three interglacial periods are recognized — the *Cromerian*, *Hoxnian* and *Ipswichian*. The latter, preceding the Last Glaciation, is the one clearly evident in the Lincolnshire Pleistocene sequence, whereas the Hoxnian and Cromerian interglacials must precede emplacement of the older tills of Lincolnshire. Allocation of the Lincolnshire glacial drifts are therefore as in Table 1, column 5.

Recent research has shown that the British ice sheets were frequently contiguous with those of Scandinavia, and responded to similar climatic oscillations. Consequently a degree of confidence prevails which permits firm correlation of the British sequence with that which is in general use for Germany and Denmark (Table 1, Col. 6). The Marsh Till was thus emplaced during the *Weichsel Glaciation* and the other tills during the *Saale Glaciation*. Use of Alpine terminology, after some of the misleading correlations made with respect to the Yorkshire and East Anglian drifts in the early decades of the 20th century is perhaps best avoided, for the Alpine ice sheets in lower latitudes were totally separate from those of north and west Europe, and may well have responded to a rather different pattern of climatic fluctuations.

It must be recommended that terms such as Chalky Boulder-clay, Great Eastern, Little Eastern, Upper Purple and Lower Purple, and Hessle should be abandoned with reference to the Lincolnshire drifts, for the following reasons.

TABLE 1

SYSTEMS OF PLEISTOCENE NOMENCLATURE

1	2	3	4	5	6	7
Holderness (after Catt & Penny, 1966)	After Zeuner, 1945	After Wright, 1914	East Anglia (after West, 1961)	Lincolnshire	Northern Europe	Alps
Hessle series Purple series Drab series	Last Glaciation	Newer Drift	Last Glaciation	Upper Marsh Till Lower Marsh Till	Weichsel Glaciation	Wurm Glaciation
Marine transgression Sewerby buried beach deposits	Last Interglacial		Ipswichian Interglacial	Cliff and platform east of Wolds Kirmington fossiliferous deposits	Eemian Inter-glacial	
Basement series	Penultimate Glaciation	Older Drift	Gipping Glaciation	Calcethorpe Till Belmont Till Wragby Till Heath Till	Saale Glaciation	Riss Glaciation
	Penultimate Interglacial		Hoxnian Interglacial		Holstein Inter-glacial	
	Ante-Penultimate Glaciation		Lowestoft Glaciation		Elster Glaciation	Mindel Glaciation
	Ante-Penultimate Interglacial		Cromerian Interglacial			
	Early Glaciation		Weybourne Crag Norwich Crag			Gunz Glaciation

Chalky Boulder-clay has been traditionally applied to the drifts of eastern England for many decades. By usage it was restricted to the Older Drift deposits and at times received elaboration, such as Chalky-Jurassic, Chalky-Neocomian, Great Chalky. Such terminology became confusing when it was demonstrated in East Anglia that not only do Chalky Boulder-clays of different composition occur but that these may be of very different age (*e.g.*, Lowestoft and Gipping Tills) and superposed in section (Baden-Powell, 1948). Further all the Newer Drift deposits south of Flamborough Head contain chalk (or originally did so) often in large quantities as for instance at Welton-le-Wold. In other localities, as at Kirmington, the chalk has been dissolved out and flint only remains. Chalk content is not therefore a sound criterion of age or affinity for the Lincolnshire drifts.

The term Great Eastern was used by Harmer in 1904 to describe what he considered to be the largest ice sheet of eastern England and the south-east Midlands which, deploying from the Fen basin, was responsible for deposition of the Chalky Boulder-clay. Yet ice reached the Thames basin in both the Lowestoft and Gipping Glaciations and Great Eastern is therefore redundant. Solomon in 1932 recognized a series of sand and gravel deposits in north Norfolk, the Cromer Ridge gravels, which he considered were younger than the Chalky Boulder-clay (Great Eastern drift) but older than the Hunstanton clay. Presuming the glaciation responsible for the gravel to have been less severe than the Great Eastern, the term Little Eastern was accorded to it. Never a satisfactory conception, a tentative attempt to delimit this glaciation as part of the Newer Drift was made by Wills on Plate 22 in his Palaeogeographical Atlas in 1951. Deposits relevant to a Little Eastern glaciation were never adequately determined in Lincolnshire, and as both a concept and a term, it has lost any value it might have had.

In Holderness, workers including Reid (1885), Kendall and Wroot (1924) and Raistrick (1929) had established a four-fold sequence of glacial drifts, in which a Basement series was overlain by Lower Purple, Upper Purple and Hessle clays, and Kendall and Wroot suggested a correlation with the Alpine sequence. As the East Anglian drifts had also been referred to this sequence, it became inevitable that east Yorkshire and East Anglian drifts should be equated, a circumstance apparently confirmed by the content of Scandinavian rocks in the Basement clays of Holderness and the oldest glacial deposits of East Anglia, the North Sea drift of Solomon (see for instance Boswell, 1931). However, in 1939, Bisat revised the sequence of Holderness drifts, and posed serious objections to former correlations with East Anglian and European deposits and glaciations. He described beds of a Purple Series (two main divisions) underlain by a Drab Series (5 divisions) and a Basement Series (2 divisions). He concluded that all the Series belonged to the Newer Drift, whereas relics of Older Drift deposits persisted only on parts of the Yorkshire Wolds. Work by Penny (1959) confirmed the Last Glaciation character of the Purple and Drab deposits, but he regarded the Basement clays as possibly of marine rather than glacial origin. After further research, Catt and Penny (1966) demonstrated four principal divisions, from oldest to youngest the Basement, Drab, Purple and Hessle. The latter three are firmly regarded as of the Last Glaciation, but the Basement Series is believed to comprise a true till (of Older Drift age) with inclusions of marine sediments (Sub-Basement). Deposition of the Last Glaciation beds is shown to follow a period of marine transgression that trimmed the surface of the Basement clays and reached the largely-buried Chalk cliff that runs from Sewerby near Bridlington to Hessle on the Humber (Table 1, Col. 1).

No direct work linking the Holderness beds to the Marsh Tills of Lincolnshire has yet been completed, but it is clear that the Marsh Tills represent some portion of the Drab-Purple-Hessle complex. The conclusions reached above that the Marsh Tills and other features record a major advance of Last Glaciation ice consequent to interglacial erosion, followed by a less extensive readvance strongly suggests that they represent the Drab and Purple members of the Holderness complex. Thus equivalents of the Drab clays are exposed at South Ferriby and Welton-le-Wold, whilst the Purple clay representative may well be the upper sheet of Marsh Till that constitutes and lies east and north of the Killingholme and Hogsthorpe moraines (Fig. 2).

The term Hessle Clay still invites controversy. Catt and Penny (1966) consider the Hessle Clay to be the most extensive till in Holderness and state that such overlapping is a feature of the Lincolnshire drifts. This however is not so, for it is the lower Marsh Till in east Lincolnshire that is the most extensive. Further, although too frequent reference is made to Hessle Clay at Kirmington and at Hunstanton in Norfolk, on all reasoned grounds the clays in these localities are also lower Marsh Till, and are correlatives of the Holderness Drab clays. It is contended here therefore that no Hessle Clay (in the present use of the term) occurs in Lincolnshire, and its usage with reference to Lincolnshire and Norfolk glacial deposits should be discontinued.

Conclusion

An attempt has been made above to clarify the circumstances relating to the Lincolnshire glacial deposits, by stating and presenting some original illustration of the sequence of events that led to their emplacement. Such a sequence conforms with recent work in Holderness and East Anglia, and a considerable amount of agreement on the extent and behaviour of ice sheets during the three major British glaciations has been achieved (Table 1, Cols. 1, 2, 4, 5). Lincolnshire however forms a completely separate physiographic unit from either of these adjacent areas and it seems to the writer to be unwise at the very least to continue to use for the Lincolnshire drifts, current and especially archaic nomenclature that is primarily applicable to adjacent regions. *It is recommended therefore that the Lincolnshire glaciations be recognized as the Penultimate/Saale and the Last/Weichsel Glaciations, separated by the Last/Ipswichian Interglacial, and further that the extant till deposits of the Penultimate Glaciation be described as the Heath, Wragby, Belmont and Calcethorpe Tills, and the Last Glaciation materials as the Marsh Till (lower and upper).* Although rather parochial, such a system should facilitate further study both of the Pleistocene history of Lincolnshire and of its present surface features, for it is clearly necessary for archaeologists, biologists and pedologists as well as geologists and geomorphologists to have a firm framework of reference for events that fall within their general sphere of interest.

Acknowledgments

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GEOLOGY

A. Straw, B.A., Ph.D.

Lincolnshire rocks and deposits have continued to interest a number of geologists and geomorphologists, and publications that have appeared over the year are appended to this report. The main interest would seem to focus on stratigraphic problems concerning the Jurassic and Cretaceous rocks of north Lincolnshire and on the deeper rocks and structures of the county. Dr. P. E. Kent would appreciate any information given him directly or through me about exposures of rocks in the northern areas, especially in temporary excavations. So far there has been little response to my request for details of rock and superficial deposit exposures, but some compilation is proceeding, and the invitation will remain open. Geomorphologically, published work over the past year has dealt with coastal and offshore features, but considerable work is in progress on periglacial deposits and features over the county, and I am currently investigating areas around South Ferriby and the Humber side cliffs, and the 'interglacial' site at Kirmington. Knowledge of the intensity and distribution of former periglacial processes acting on bedrock and glacial drift over the county has considerable relevance to the study of soils, and sometimes to engineering problems, and depends heavily on observations of temporary exposures.

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BOTANY

Miss E. J. Gibbons, F.L.S.

In a summer of frequent heavy rain and high water level, it has been difficult to get out and about in the field as much as usual. However, the field meetings have been mostly without rain, at any rate for part of the day. The **Nature Trails** at Limber and Well Vale were patronised by many people who love to

see tress and to have a country walk, but they were not really interesting botanically and it was not the best time of the year for woodland plants. The flora in Limber Woods is chiefly chalk pasture plants in the rides; Tuberous Bitter Vetch (*Lathyrus montanus*), Restharrow (*Ononis repens*), Hairy St. John's Wort (*Hypericum hirsutum*) and Pyramid Orchid (*Anacamptis pyramidalis*) were seen.

The first field meeting at **Broughton Far Wood** was early and the woodland plants were not yet in profusion. Moschatel, Wood Sorrel and Bird Cherry were seen near the road and, further in, Yellow Archangel, Wood Speedwell, Early Purple Orchis and leaves of Lily of the Valley. Ramsons, Yellow Pimpernel and Water Avens were also seen.

At **Baston Fen** it was not very good weather. The Willows were in full flower and the White Fen Comfrey (*Symphytum officinalis* var. *ochraleuca*) and Water Violet (*Hottonia*) were seen blossoming in one part. This is a very interesting spot later in the season, when the Greater Spearwort makes a lovely show.

Dembleby Thorns proved disappointing and flowers were very scarce. Possibly it may have been fouled by a rookery. A few Early Purple Orchis were found and some Adderstongue. In Long Hollow, Purple Milk Vetch (*Astragalus danicus*) and close by, Sainfoin were in flower. A small covert had some cornfield weeds as pheasant food, including Corn Gromwell (*Lithospermum arvensis*). Several hedges contained much Buckthorn (*Rhamnus catharticus*).

Claxby Mill Hill Quarry was full of flowers, much Scabious and Marjoram, several Bee and Pyramid Orchids. Later, in Hoplands Wood, we saw Lady's Mantle (*Alchemilla vestita*), Wood Speedwell (*Veronica montana*) and several uncommon ferns. In Welton Wood it was too late to find much.

Scotgrove Wood had changed a good deal since our visit in 1953. Young trees are growing up and rides opened out. Remnants of the old woodland flora were found including Broad-leaved Helleborine. In the gully behind the wood was a mass of flowers, a few Bee Orchids and a tangle of Dodder (*Cuscuta epithymum*), which was unexpected. Milkwort, Centaury and Restharrow (*Ononis spicata*) made a fine show with other more usual plants.

Kirton Lindsey Quarries. There were many more Bee Orchids in both quarries than seen there previously, Pyramid Orchids were abundant and Tall Broomrape (*Orobanche elatior*) was flourishing on Knapweed (*Centaurea scabiosa*) in the first quarry. Ploughman's Spikenard was frequent, also Milkwort, Melilot and Fern grass. Basil Thyme (*Acinos arvensis*) was noticeable in having white as well as purple flowers.

Haxey Turbary and Birds Wood. Haxey Turbary has been dug out a great deal for turf or peat, is very uneven in surface and scrub is invading it. Birds Wood has in recent times gone back to birch and oak scrub and the ground flora is in a state of re-establishing itself. It is sandy and not sufficiently wet to produce a bog flora. Haxey Turbary has relics of a former bog flora with Sedge (*Cladium mariscus*) and Meadow Thistle (*Cirsium dissectum*) and three kinds of heather.

Sotby. This wood is really in Hatton parish, the old road from Lincoln being the boundary. The Forestry Commission metalled rides were most useful when the rain began. The road verges were gay with flowers in one part: Eyebright, Centaury, Hairbells and Trailing St. John's Wort were doing their best. One or two plants of heather (*Calluna*) were a surprise; also Pepper Saxifrage (*Silaum*) as an old clay pasture plant and Wood Cudweed on sand.

Skidbrook and North Somercotes. A start was made with saltmarsh and sand dune plants at Skidbrook Lane End, where accretion was explained. One plant of Wood Cudweed was found; much Slender Vetch (*V. tetrasperma*), Knotted Pearlwort (*Sagina nodosa*) and Sea Buckthorn were on the dunes. On part of North Somercotes Warren, an inland dune isolated from the sea by slatmarsh reclamations, the Forestry Commission has planted conifers. There are also several freshwater lagoons with an interesting flora with much Eyebright and Yellow Wort and a good variety of grasses. At Saltfleetby in June the South Humberside Group re-found Large Bittercress (*Cardamine amara*) and Lesser Water Plantain (*Baldellia ranunculoides*) which had not been found for some years.

Gibraltar Point Weekend for Juniors. Though late in the season it was possible to find Sea Wormwood, a little of two kinds of Sea Lavender (*Limonium vulgaris* and *binervosa*) and a little Sea Holly still flowering. One or two plants of Ray's Sea Knotgrass turned up, recorded here by Rev. G. S. Streatfeild in 1870. Several new bushes of Shrubby Seablite were noted on the outer dunes and a mass of Clematis on Buckthorn on the older dunes not recorded here till 1960.

Stoke Rochford Fungus Foray. It was possible to identify some calcareous plants by their leaves on a bank above the lake on the golf course. These were Rockrose, Hairy Violet, Burnet Saxifrage, Dropwort Spirea, Cowslips and Stemless Thistle. In a marshy corner Marsh Pennywort, Ragged Robin, Bogbean, Early Marsh Valerian and Hop were found.

Two very interesting old Herbaria have been brought to my notice recently, both dated about 1830. One is from Ipswich, collected by Rev. J. F. Wray, son of the Vicar of Bardney. (He became Vicar of Stixwould, 1839). The other was collected by Rev. R. J. Bunch, Fellow of Emmanuel College Cambridge and later Vicar of Emmanuel Church, Loughborough. It is now at Leicester University. These two men collected specimens together on several occasions, but Bunch lived in Lincoln and found plants at Skellingthorpe and the drain beyond the race course, as well as many other places in England and elsewhere.

County Record

Euphorbia uralensis	3	F. Lammiman

Divisional Records

Agropyron caninum	3	E. J. Gibbons
Callitriche obtutusangulum	10	B. Howitt
Galinsoga parviflora	13	R. M. Burton
Gnaphalium sylvaticum	9	K. E. Gipps
Medicago falcata	9	G. S. Phillips

NOTES ON THE FLORA OF TWO DISUSED RAILWAY TRACKS IN SOUTH LINCOLNSHIRE

C. R. Warren, F.L.S.

The first section is that of about 1½ miles between Little Bytham and Castle Bytham on the disused Bourne to Melton Mowbray line. It is situated completely on the oolitic Lincolnshire limestone.

Starting at the bridge near Castle Bytham we first encountered a large bed of *Acinos arvensis* (Basil-Thyme). This covered a stony bank and was surrounded with *Achillea millefolium* (Yarrow) and the yellow flowers of *Pastinaca sativa* (Wild Parsnip). Also beside the track were *Reseda lutea* (Wild Mignonette) and white flowers of *Silene vulgaris* (Bladder Campion). *Prunella vulgaris* (Self-heal) was also quite abundant along the whole of the track having, in patches, pink flowers; *Ononis repens* (Rest-harrow) crept along the stonier parts of the track with trailing *Convolvulus arvensis* (Field Bindweed).

About halfway between the two villages on a high, south-facing, limy bank were *Centranthus ruber* (Red Valerian) with *Chrysanthemum leucanthemum* (Ox-Eye Daisy) and *Centaurea scabiosa* (Greater Knapweed). On the verge further along were *Hypericum perforatum* (Common St. John's Wort), *Rhinanthus minor* (Yellow Rattle) and *Anthyllis vulneraria* (Kidney Vetch). The special plant of this particular section of track is *Orobanche elatior* (Tall, or Knapweed, Broomrape). It is here parasitic upon *Centaurea scabiosa* which grows freely beside the track, on both sides. This part of the track also offers blooms of *Cirsium acaulon* (Stemless Thistle) and *Centaurea nigra* (Hardhead).

The second section is between Braceborough and Essendine (on the old Bourne — Essendine line) again largely on oolitic limestone. Most of this track is now impassable, with bramble and hawthorn, but the section from the old station house at Braceborough Spa, westwards along the track for about a mile, is easy walking.

Malva moschata (Musk Mallow) and *Hypericum perforatum* (Common St. John's Wort) were flowering together by the steeply-banked brook that crosses the line near the station remains. Here also abounds the tall *Reseda luteola* (Weld) and *Filipendula ulmaria* (Meadowsweet); *Mentha aquatica* (Water Mint) is to be found in the ditches by the track with *Sanguisorba officinalis* (Great Burnet) and its relation, *Agrimonia eupatoria* (Agrimony). *Clinopodium vulgare* (Wild Basil) grows abundantly on the verge of the track and *Betonica officinalis* (Betony) shows its brilliant flowers in profusion on the drier banks with *Dipsacus fullonum* (Wild Teasel).

Ononis repens (Rest-harrow) and *Cirsium acaulon* (Stemless Thistle) are on the very edge of the track; with them are *Convolvulus arvensis* (Field Bindweed) and *Calystegia sepium* (Great Bindweed) both creep in and around the surrounding hedgerows. *Pulicaria dysenterica* (Common Fleabane) grows in the ditches about here with *Vicia cracca* (Tufted Vetch). *Melandrium dioicum* (White Campion) together with *Anagallis arvensis* (Scarlet Pimpernel), *Stachys sylvatica* (Hedge Woundwort) and *Galium verum* (Lady's Bedstraw) were also noted.

MYCOLOGY

H. J. Houghton

1968 was a succession of warm spells and wet spells, and as a consequence the fruiting bodies of the larger fungi have been very much in evidence both in species and quantity for the greater part of the year. In fact in October, 'Blue Stalks', (consisting of both *Lepista saeva* and *Lepista nuda*) were being offered in numerous lots of 4 and 7 lbs. each in the auction markets at Gainsborough. They are, of course, able to withstand some degree of frost, and were still being sent to market in December.

At Broughton in April, although it was rather early in the year, 15 species of fungi and 3 myxomycetes were collected. The main item of interest was the numerous specimens of the common Morel, *Morchella esculenta*, which were gathered. Other types consisted of the usual lignicolous species, together with a few coprophils.

At Dembleby Thorns in June, 21 species of fungi and 4 myxomycetes were collected, and comprised a mixed bag of agarics and other basidiomycetes and some smaller ascomycetes, including *Scutellinia scutellata*, *Dasyscyphus niveus*, *Exidia albida* and the spring species *Agrocybe praecox*. Conditions at Claxby later in the month were rather dry, and only ten species were recorded. These included some very large specimens of *Polyporus squamosus*, three *Coprinus* species, and the smut *Farysia olivacea* on the Greater Pond Sedge (*Carex riparia*).

At Scotgrove Wood in July, conditions were again dry, and 15 species of fungi and one myxomycete only were found. The most notable item in this case was a considerable quantity of chanterelles, (*Cantharellus cibarius*) much to the delight of some mycophagists present. On the following day in the quarries at Kirton Lindsey, neither the very dry weather nor the dusty terrain were suitable for fungi, although there were exciting botanical finds, and the only species seen was the common smut *Ustilago avenae* on the grass *Arrhenatherum elatior*.

The North Somercotes meeting in September again produced very few species. Thirteen species was the sum total, but lack of quantity was made up up for by quality, since the rare cup fungus, *Peziza ammophila* was found among the Marram Grass in the sand dunes. Also collected was *Volvariella speciosa*, which in some years is rare, but in others (as this year) is plentiful. There were large quantities of the rust *Puccinia poarum* on Coltsfoot leaves and ergots of *Claviceps purpurea* on the grass *Agropyron pungens*.

After introductory talks the previous Friday, the South Humberside Group had a fungus foray in Roxton Wood on one Sunday in mid-October. We did not again find *Clavaria biformis* (which proved to be a new European record at the foray in 1966), but 8 myxomycetes and over 90 other species were found. It is hoped that some new records will result, despite the area being well-worked on previous occasions.

We were very fortunate to have the services of Dr. J. Webster of Sheffield, to lead the annual Foray at Stoke Rochford. Whilst fungi were not present in large numbers, some interesting species were collected, including *Peziza vesiculosa*, *Fomes annosus* and *Geaster triplex*, and on an old stack numerous specimens of *Peziza cerea* and the Bird's Nest fungus *Cyathus olla* were photographed and collected. One agaric on a dead trunk proved to be *Rhodotus palmatus*.

Specimens and lists have been sent in this year by Miss W. Heath, Mrs. Z. Porter and Messrs. P. Wood, D. Brazier, G. N. Holland, M. R. D. Seaward and Dr. M. M. Lubin.

BRYOLOGY AND LICHENOLOGY

M. R. D. Seaward, M.Sc., M.I.Biol.

A further account of the bryological and lichenological work in Lincolnshire by F. A. Lees (see also: *Lincs. Nat. Union Trans.*, **17,** 33), together with a comprehensive list of his herbarium material now housed in the Cartwright Hall, Bradford, have been published during the past year (Seaward: F. A. Lees' Botanical Collections, Part 2. *The Naturalist*, 1968, 133 — 135). Lees' herbarium in the Cartwright Hall was purchased in 1905 by the Bradford Corporation. The 25,000 specimens of flowering-plants, ferns, bryophytes and lichens have unfortunately received little attention since their purchase. Examination of the material to date has been most rewarding, and the collection provides an excellent foundation for Lincolnshire and Yorkshire flora studies. The bryophyte material, together with that housed at the City and County Museum, Lincoln, constitutes a comprehensive reference collection and substantiates the majority of the records published in Lees' *Outline Flora*.

Another contribution to the knowledge of the Lincolnshire bryophyte and lichen floras ninety years ago has been obtained from gleanings of the minute books (5/5/1875 — 24/10/1877; 7/11/1877 — 17/4/1886) of the Goole Scientific Society, now entrusted to the Goole Public Library.

Moss Vice-County Records

1/1 *Sphagnum palustre* L. Norton Disney Wood (VC 53), May 1968. Miss W. Heath

47/1 *Eucladium verticillatum* (With). B., S. & G. South Stainby (VC 53), 1878. W. Fowler (Herb. Bradford).

51/5 *Trichostomum brachydontium* Bruch Waddingham Common (VC 54), Nov., 1963, M. Seaward.

71/2 *Orthodontium lineare* Schwaegr. Doddington Woods (VC 53), March, 1961, M. Seaward.

Moss Divisional Records

1/27 *Sphagnum plumulosum*. 7/1968, MS, 1
5/11b *Polytrichum commune* var. *perigoniale*. 4/1959, MS, 7
8/17 *Fissidens adianthoides*. 6/1879, HFP, 2
22/4 *Dicranella varia*. 3/1879, HFP, 2
27/1 *Dicranoweissia cirrata*. 7/1968, MS, 1: 8/1959, MS, 5
31/4 *Campylopus fragilis*. 9/1878, HFP, 1
31/5 *C. pyriformis*. 7/1968, MS, 1
31/6 *C. flexuosus*. 9/1878, HFP, 1
33/1 *Leucobryum glaucum*. 9/1878, HFP, 1
41/2 *Phascum cuspidatum*. 7/1968, MS, 1
44/7 *Barbula fallax*. 7/1968, MS, 1
52/1 *Weissia controversa*. 6/1879, HFP, 2
71/2 *Orthodontium lineare*. 7/1968, MS, 1
77/23 *Bryum caespiticium*. 8/1962, MS, 8
77/29 *B. rubens*. 7/1968, MS, 1
126/3 *Campylium chrysophyllum*. 1879, FAL, 7
133/1 *Scorpidium scorpioides*. 1877, FAL, 3
135/2 *Isothecium myosuroides*. 1966, ADH, 7
138/1 *Brachythecium albicans*. 7/1968, MS, 1
138/5 *B. mildeanum*. 1879, FAL, 7
140/1 *Cirriphyllum piliferum*. 8/1966, MS, 2
141/1 *Eurhynchium striatum*. 7/1968, MS, 1: 8/1966, MS, 2; 7/1963, MS, 3
141/8 *E. riparioides*. 7/1967, MS, 6
160/2 *Rhytidiadelphus squarrosus*. 7/1968, MS, 1

Hepatic Vice-County Record

10/5 *Riccia glauca* L. Lincolnshire Gate, Holywell (VC 53), Oct., 1968, J. H. Chandler. There is a record for Caythorpe (Stow, 1904) not substantiated by herbarium material

Hepatic Divisional Records

11/1 *Ricciocarpus natans*. 10/1968, JHC, 17
14/1 *Pellia epiphylla*. 7/1968, MS, 1
46/8 *Solenostoma cremulatum*. 1879, FAL, 7
57/1 *Lophocolea bidentata*. 7/1968, MS, 1
57/2 *L. cuspidata*. 7/1968, MS, 1
82/1 *Frullania tamarisci*. 6/1879, HFP, 2
82/5 *F. dilatata*. 6/1877, GSS, 2

ADH — A. D. Horrill; FAL — F. A. Lees; GSS — Goole Scientific Society; HFP — H. F. Parsons; JHC — J. H. Chandler; MS — M. R. D. Seaward.

Lichen Check-List

The following are further divisional records to the Lincolnshire check-list; vice-county records are indicated by an asterisk, and older records are given in parentheses:

Caloplaca aurantia (Pers.) Hellb.	1, 2, 13
C. citrina (Hoffm.) Th. Fr.	1, 2, 10
C. decipiens (Arnold) Jatta	6*, 10
C. heppiana (Müll. Arg.) Zahlbr.	1, 10
C. holocarpa (Hoffm.) Wade	1, 10
C. murorum (Ach.) Th. Fr.	10, 13*
Candelariella aurella (Hoffm.) Zahlbr.	1-3, 10*, 13
C. medians (Nyl.) A.L.Sm.	2
C. vitellina (Hoffm.) Müll. Arg.	1, 10, 14, 18
Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.	1
C. coccifera (L.) Willd.	1, 10
C. floerkeana (Fr.) Sommerf.	10
C. scabriuscula (Del. ex Duby) Leight.	1
C. squamosa (Scop.) Hoffm.	1
C. tenuis (Flörke) Harm.	(7)*
Collema cristatum (L.) Web.	(2)
Evernia prunastri (L.) Ach.	(2)
Lecanora calcarea (L.) Sommerf.	1
L. campestris (Schaer.) Hue	1, 2, 10
L. chlarotera Nyl.	(2)
L. conizaeoides Nyl. ex Cromb.	14
L. dispersa (Pers.) Sommerf.	1, 10, 14
L. muralis (Schreb.) Rabenh.	1, 10
L. subcircinata Nyl.	(2)
Lecidea granulosa (Hoffm.) Ach.	1
L. limitata (Scop.) Gray	(2)
L. lucida (Ach.) Ach.	17, 18
L. macrocarpa (DC.) Steud.	16*
L. stigmatea Ach.	1, 10
L. uliginosa (Schrad.) Ach.	1
Lepraria incana (L.) Ach.	1, 18
Parmelia caperata (L.) Ach.	(2)
P. physodes (L.) Ach.	1, 2
P. saxatilis (L.) Ach.	2, 13
P. sulcata T. Tayl.	4
Pertusaria amara (Ach.) Nyl.	(2), 13
Phlyctis argena (Ach.) Flot.	1, 2
Physcia adscendens (Th. Fr.) Oliv. em. Bitt	1-3
P. caesia (Hoffm.) Hampe	1
P. grisea (Lam.) Zahlbr.	1, 6, 10
P. orbicularis (Neck.) Poetsch	1, 6
P. tenella (Scop.) DC. em. Brit.	13
Ramalina fastigiata (Pers.) Ach.	(2)
Rinodina subexigua (Nyl.) Oliv.	13*
R. teichophila (Nyl.) Arnold	16*
Solorina saccata (L.) Ach.	(2)
Verrucaria muralis Ach.	1, 2, 10
V. nigrescens Pers.	1, 10
Xanthoria aureola (Ach.) Erichs.	1, 2

VERTEBRATE ZOOLOGY

M. Johnson, f.z.s.

Support for this section continues to increase, and particularly I would like to thank Mr. V. H. Knight and Mr. P. J. Wilson who, in spite of their occupation with the Breeding Bird Survey, still found the time to collect owl pellets from many different parts of the county for me to analyise. The highlight of the year was the rediscovery of the *Harvest Mouse* in the county and much of my time has been taken up in obtaining information on its present-day status in the county.

MAMMALIA

A single roe deer had been seen at Laughton Forest in February and red squirrels were frequent. In March Mr. V. H. Knight and I visited a badger sett on the Wolds and found a small badger cub which had been freshly killed, badly bitten about its hind-quarters. Also in this locality we noted that a number of fox droppings contained rubber bands. We discovered that the foxes had been eating the lambs tails which had dropped off after docking, also swallowing the rubber docking bands.

On March 25th, Mr. V. Knight brought in a harvest mouse skull which he had taken from an owl pellet as this was the first real evidence for the presence of the *Harvest Mouse* in the county for many years. Identification was confirmed by Dr. Corbet of the British Museum and I started a full scale search for further evidence of this interesting little mammal in the county (see below).

Stoats and *Weasels* are numerous in many parts of the county. One large stoat which was killed by a car on the road near Caenby Corner was brought in by Mr. Rowe for me to examine. Although it appeared to be unmarked, on skinning I found that its skull was shattered like an egg-shell.

Both *Common* and *Grey Seals* occurred along our coastline during the year. A report on a survey of the common seal has been received from Mr. K. H. Reaney for our records. A grey seal still in its white puppy coat was found dead at Huttoft on October 7th.

Bat records during the year include *Noctule Bats* at Partney and Sudbrooke; the skull of a *Whiskered Bat* from an owl pellet in the Stapleford area; a dead *Long-eared Bat* near Lincoln Cathedral. During August I was called to a house in Winterton where a householder was troubled by the presence of a colony of bats in the loft. Assisted by Mr. P. J. Wilson I managed to net most of the bats which were *Common Pipistrelles* and transfer them to a colony in the Lincoln area.

REPTILIA

A fine *Slow-worm* was seen in Glad Wood by Mr. P. J. Wilson and the *Common Lizard* (*Viviparous Lizard*) has been reported from Cherry Willingham area during April, and from Laughton Forest area during August. *Grass Snakes* have been seen on Barlings Pits and at Reepham. *Adders* have again been seen at Linwood Warren, and I saw a fine specimen in the Laughton Forest area during August.

AMPHIBIA

The survey of ponds containing amphibia continues to make progress and a number of new localities containing frogs, toads and newts have been examined during the year. Ponds and Forestry Commission static water tanks examined on Laughton forest area were found to contain frogs, toads and

newts. A board placed at Barlings Pits to attract small mammals had been used by *Crested* and *Smooth Newts* as hibernating quarters, and two *Crested* and four *Smooth Newts* had crawled into the hair lining of an old matress.

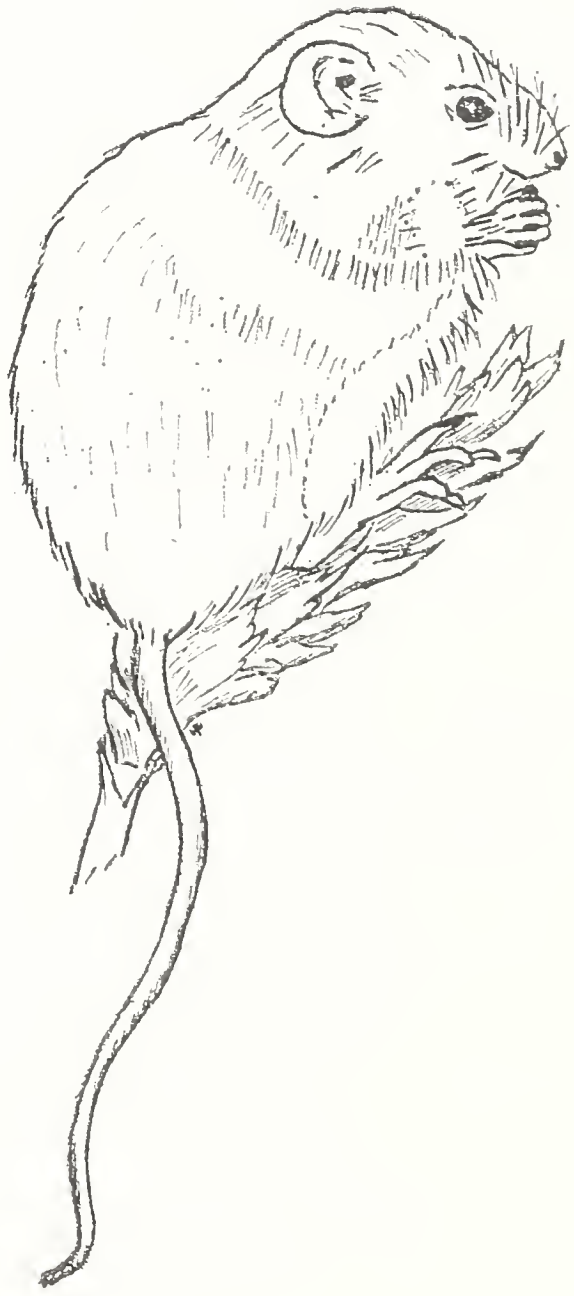
A PRELIMINARY REPORT OF THE DISTRIBUTION OF THE HARVEST MOUSE IN LINCOLNSHIRE

M. JOHNSON, F.Z.S.

The only records on the occurrence of the Harvest Mouse (*Micromys minutus*) in Lincolnshire are to be found in the Preliminary List of Lincolnshire Mammals by the Rev. F. L. Blathwayt which is published in the *Transactions* for 1912 (p. 65). Because of the scarcity of records at that time it was described as a very rare mammal in the county. Since then not a single record of its occurrence has come to light in the county, so that the discovery of the skull of a Harvest Mouse in an owl pellet found at South Carlton on March 23rd, 1968 encouraged me to start a new investigation into the present-day status of this interesting little mammal in the county.

The Barn Owl (*Tyto alba*) is a fairly common bird in Lincolnshire and with the assistance of two ornithologists I was able to visit and collect owl pellets from thirty different Barn Owl sites in various parts of the county. The results of my analysis of these pellet samples exceeded all my expectations and by September I had examined 2,650 animal skulls among which were thirty-one harvest mouse skulls:

Field Vole	1,240
Common Shrew	539
Wood Mouse	269
Bank Vole	171
Brown Rat	91
Lesser Shrew	76
Water Vole	34
Harvest Mouse	31
House Mouse	30
Water Shrew	15
Mole	2
Rabbit	2
Whiskered Bat	1
Birds	149
	2,650



HARVEST MOUSE
Drawn by Joyce Robinson.

A close investigation of some of the 10 km square areas in which Harvest Mouse skulls had been found resulted in the discovery of a number of breeding nests, not one of which was found in corn. They were in hawthorn and birch scrub and one in a spruce tree situated on rough grassland, and varied in height above ground from 2 to 5 feet. Several nests were found which had been built in rough grass about 4 ins. above ground level. A watch for many hours was made by Mr. V. H. Knight and myself in the most frequented areas but no mice were observed. A dead Harvest Mouse was discovered in the open excavation of an archaeological site at Normanby-le-Wold, but no nests were discovered; also a dead adult harvest mouse picked up among buckthorn bushes at the Gibraltar Point Nature Reserve.

ENTOMOLOGY

G. N. Holland, B.Sc.

Field Meeting highlights in 1968 included a Brown Silver-lined moth at Far Wood and a Small Fanfoot moth at Dembleby Thorns (apparently not recorded in the county since 1965). At the night meeting at Hatton Wood 66 species of moths were recorded, including Heath Rivulet, Small Rivulet, Beautiful Carpet, Wood Carpet and Green Carpet, Marble White-spot and Blotched Emeralds. I reared the 'micro' Teazle Long-cloaked Marble from larvae found in teazle heads at Baston Fen, this species not having been recorded since 1907.

Reports for additions to the records have been received from Mark Weston, G. L. A. Posnett, R. L. Goy, A. D. Townsend, Rev. Canon G. Houlden, A. E. Smith (Boston), Mrs. E. E. Holland, Miss N. Goom, Mrs. Lissett, Mr. J. H. Duddington and Dr. R. E. M. Pilcher. I have recorded the Twin-barred Knot-horn for the first time from the South Rauceby Warren Nature Reserve. A county record was the Blotched Marble (micro) I took at light at Gosberton Brick Pits Nature Reserve in August. Mr. Duddington includes mention of an influx of Red Admirals in the Scunthorpe area, and Dr. Pilcher claims the only two records for Webbs Wainscot, one taken at his South Thoresby light trap; he also notes five Portland Moths and two Coronet Moths (the latter not recorded since 1900). The Rothamsted Experimental Station is making a survey of the distribution of Lepidoptera and is collecting data from light traps at Riseholme, Caythorpe and Gibraltar Point.

Other orders: With the kind help of Mr. E. C. Riggall, I have been able to name several beetles this year, many of which have been found by energetic junior members at field meetings. These include the attractive 'Longhorn' *Anaclyptus mysticus* (Sleaford, June), one of the large Dor Beetles *Gestrupes spiniger* (Sleaford, September), an unusually large Wasp Beetle *Clytus arietis* (Sudbrooke, June) — a harmless insect which secures some protection by mimicing dangerous ones, the metallic green weevil *Polydrusus pterygomalis* (Scotgrove Wood), the shiny blue *Sermylassa halensis* (Skidbrooke), the attractive Longhorn beetle *Rhagium mordax* (Far Wood, April) — its larvae are considered useful forest scavengers as they feed on decaying trees, two large black ground beetles *Abax parallelopipedus* (Far Wood, April), the green weevils *Phyllobius parvulus* (Baston Fen, May) — on stinging nettles, a large weevil *Cleonus piger* (Gibraltar Point, September) — it occurs on thistles, chiefly near sandy coasts; newly emerged specimens are almost completely grey, but the dark markings become more pronounced with age, and the Hardback Beetle *Tenebrio molitor* (Thorpe Tilney) — its larvae are known as yellow mealworms and, although they are a great nuisance to the miller and storekeeper, they are bred by naturalists for feeding insectivorous mammals and birds.

REPORT OF THE HON. GENERAL SECRETARY, 1968-69

During 1968 twelve Field Meetings were held, including a visit to the Monks Wood Experimental Station of the Nature Conservancy. Conservation was the main theme for the meetings. Due partly perhaps to poor weather, total attendances were some 50% down on the previous year, The Botany Report elsewhere in this issue lists the Field Meetings held in the county and includes a very successful weekend for Junior members at Gibraltar Point attended by 24 Juniors from all parts of the county. In June a successful Day Course: "How to Use a Flora" was organised by Lindsey College of Agriculture (to whom we are very grateful) where 28 enrolled.

The South Humberside Group continues to flourish and is able to supplement the main Union Field Meeting with local ones, as well as a full winter programme. Of particular value were those meetings which combined teaching demonstration with field study.

The winter programme started with Mr. G. S. Phillips' colour-slide talk on "Wild Flowers and their Pollination", attended by some 40 members. There were about 60 present in November to hear Section Officers' Reports, the main points of which appear in reports in this issue. At the joint meeting with the Lincolnshire Trust for Nature Conservation Mr. R. P. Bagnall-Oakley's fine ornithological films attracted nearly 100 people and the General Secretary's lecture in January, similarly organised, on "The Geology of the Lincolnshire Wolds" was attended by some 60 people. The February Photographic Section meeting continues to have a very interested following as it gives members a chance to show their own work.

The Executive Committee will again have met four times during the year, one of the main things being the successful registration of the Union as a charity. Among other advantages this enables the recovery of tax from covenanted subscriptions, and it is hoped that as many members as possible will take this opportunity of increasing the funds of the Union without any additional cost to themselves.

RICHARD KINAHAN CORNWALLIS, 1915-1969

The untimely death of Dick Cornwallis on 11th January, 1969 at the age of 53 was a grievous loss to his many friends and to the organisations with which he was associated in farming, nature conservation and ornithology. In so many of these, not least in the Lincolnshire Naturalists' Union and the Lincolnshire Trust, his outstanding qualities had brought him to positions of leadership where he will indeed be hard to replace.

The son of a distinguished father, he was educated at Winchester and Trinity College, Oxford. He came to Lincolnshire to farm in 1939 and settled at Bleasby Grange where he lived for the rest of his life. Others have written of his work for agriculture, in particular for the National Farmers' Union of which he

was County Chairman in 1964 and 1965. As a progressive farmer and leader of opinion in the N.F.U. and as an ornithologist and conservationist of national repute he occupied a unique position and he was the obvious choice as the N.F.U.'s first representative on the Lindsey Countryside Committee.

Nationally, too, he became one of the most eminent authorities on the impact of modern agriculture on the countryside and its wildlife. Many of his later papers and speeches were on this theme. He understood the necessity for change in agriculture but he sought to influence and to guide it in order to retain and recreate variety and beauty in nature and landscape.

He had been a keen ornithologist at Oxford and he resumed his study of birds when he settled in Lincolnshire. He was closely associated with the Gibraltar Point Bird Observatory almost from its beginning in 1948 and he became joint editor of the Observatory report in 1950. He was appointed Ornithological Secretary of the Union in 1955, an office which he held until 1963 when he was elected President of the Vertebrate Zoology Section and then, in 1967, of the newly created Ornithology Section. Meantime he was President of the Union in 1952 and 1953 and gave two outstanding addresses, "The Nature of a Bird's World" and "Bird Migration and Populations". He was co-author of *The Birds of Lincolnshire* published by the Union in 1955. He gave a new direction and a new depth to Lincolnshire ornithology laying the foundation for many of the developments which have recently taken place.

He quickly established a national reputation as an ornithologist and was a frequent contributor to ornithological journals on many aspects of bird migration and distribution, his special interests. He was co-author of *The Bird in the Hand*, the British Trust for Ornithology's field guide for ringers and bird observatory workers, and he wrote the section on "Irruptions" for the *New Dictionary of Birds* published in 1964. He played an important part in the affairs of the B.T.O. occupying a number of offices including that of Vice-President which he held to the time of his death.

To the cause of conservation he devoted himself whole-heartedly. He was Assistant Secretary of the Trust through all its vital formative years from 1950 to 1963. He became President for two years in 1963 and 1964 and from that time until his death he was the Chairman. He brought to the Trust's affairs through all those years a rare wisdom, a lucid mind and a breadth of vision for which the Trust and the cause of conservation in Lincolnshire must always be immeasurably indebted.

Nationally, he served on the Committee for England of the Nature Conservancy and he played a leading role in the Society for the Promotion of Nature Reserves, the national association of the County Trusts. He made a major contribution to all the County Trusts' Conferences and to many others concerned with land use, agriculture and conservation.

He remained, in spite of all his achievements and popularity, a modest and unassuming man, warm-hearted, generous and always good humoured. Few have enjoyed such universal respect and affection or will be remembered so warmly and so gratefully. Whatever the form by which we commemorate his life and work, he would have wished for nothing better than the progress and success of the organisations and causes for which he worked.

A. E. Smith.

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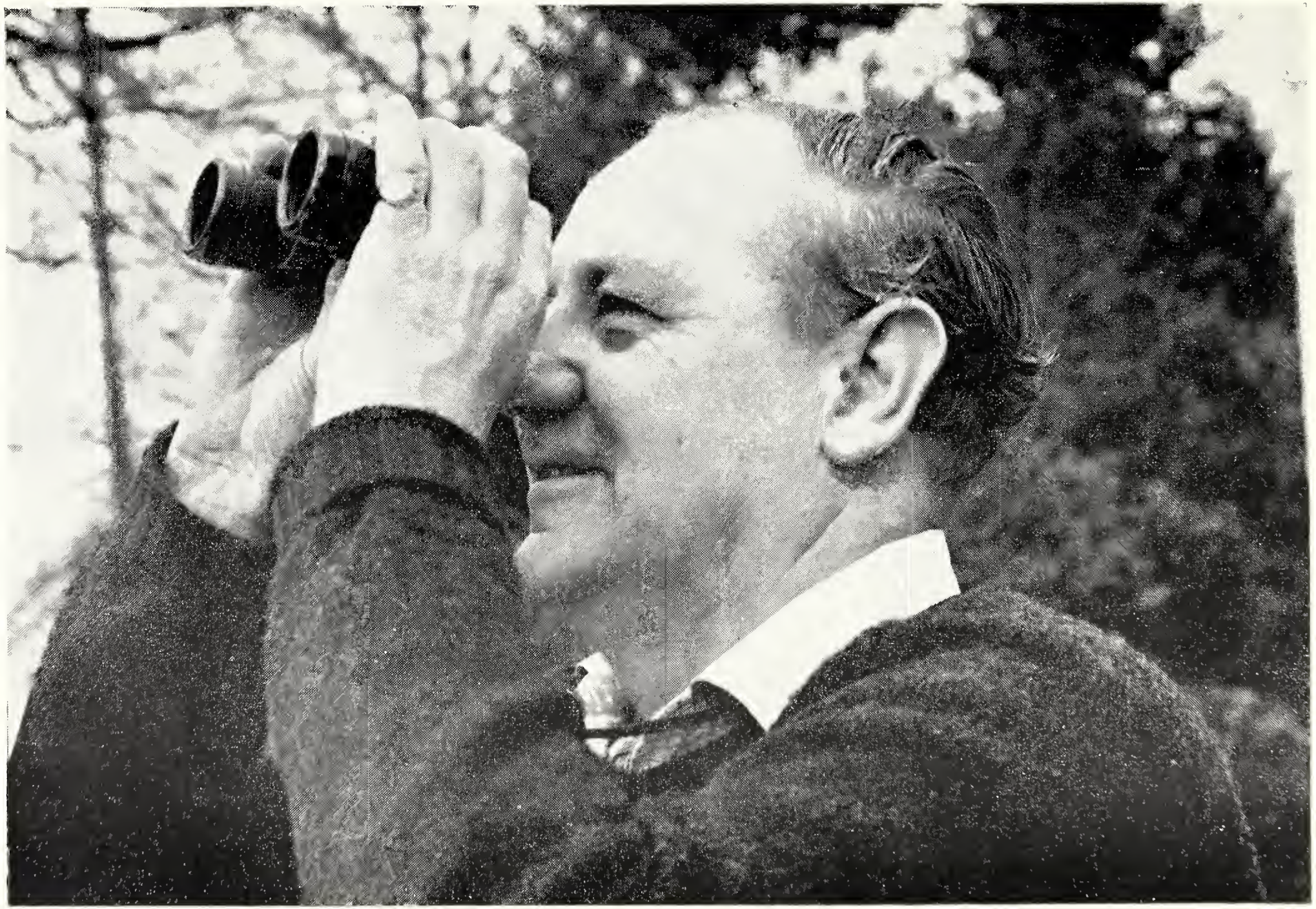
BRITISH MUSEUM
31 MAR 1969



R. K. CORNWALLIS, M.A., M.B.O.U., 1915 — 1969

Photograph by courtesy Lincolnshire Standard.

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"Personalities, Profile No. 19: A. E. Smith". *Bird Notes*, 31, 12 (Royal Society for the Protection of Birds).

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